

CONTRACT DOCUMENTS

WPC Sludge Dewatering Improvements

City of Flint
1101 S. Saginaw Street
Flint, MI 48502

April 2020

COF107201F

PREPARED BY:



**WADE
TRIM**

555 South Saginaw Street
Suite 201
Flint, MI 48502



HUBBELL, ROTH & CLARK, INC
Consulting Engineers

555 Hulet Drive
P.O. Box 824
Bloomfield Hills, MI 48303



OSBORN
ENGINEERING

1100 Superior Avenue
Suite 300
Cleveland, OH 44114

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Division 00
Procurement and Contracting Requirements



Sheldon A. Neeley
Mayor

CITY OF FLINT
Finance Department
Division of Purchases & Supplies

Joyce A. McClane
Purchasing Manager

INVITATION TO BID

OWNER:

THE CITY OF FLINT
DEPARTMENT OF PURCHASES AND SUPPLIES 1101 S. SAGINAW STREET, ROOM 203
FLINT, MI, 48502

Project Name: WPC Sludge Dewatering Improvements

Proposal No.: 20000582

SCOPE OF WORK:

The City of Flint, Department of Purchases & Supplies, is soliciting sealed bids for providing:

The partial demolition and renovation of an existing building at the Water Pollution Control Facility, including but not limited to partial demolition of an existing 1-story structure and the construction of a 1-story wall for the portion of the structure that is to remain; construction of a new exterior wall along with two (2) overhead doors; the partial demolition of a large bank of windows and the construction of an exterior wall to take their place; the construction of an interior wall to create a new and separate room for the proposed solids dewatering equipment and appurtenances; upgrades and/or modifications to the existing electrical system including demolition of existing panels, conduit, and wiring, as well as new panels, conduit and wiring; separation of the existing ventilation system and installation of a new ventilation system with BACnet network to interface with the WPCF's existing HVAC control system for the partitioned area; two (2) centrifuges including necessary piping, valves, pumps, motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; and a polymer feed system consisting of two (2) polymer skids, a 6,000-gallon HDPE storage tank, piping, valves, pumps, mixing system, filling station, instrumentation and SCADA controls; two (2) horizontal split-case pumps, including motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; connection to existing sludge piping and the construction of new sludge transfer lines to the proposed centrifuge equipment, including pipe, bends, fittings, and valves as well as instrumentation and SCADA controls.

If your firm is interested in providing the requested services, please submit one (1) original, one (1) electronic copy, one (1) unbound copy of your bid in a sealed envelope to the City of Flint, Department of Purchases by **Wednesday, July 1, 2020 @ 1:00 PM EST**. The outside of the envelope should clearly identify the project name and number, and the name and address of the Bidder. Please note: all bids received after 1:00 PM (EST) will not be considered. Faxed bids to the Purchasing Department will not be accepted. Bidding Documents shall meet requirements set forth in Specification Section 00 21 13, Instructions to Bidders.

A **virtual** mandatory pre-bid meeting will be held on **Thursday, June 11, 2020 @ 9:00 AM EST, followed by an in-person tour** at the City of Flint's Water Pollution Control (WPC) Facility at G-4652 Beecher Road, Flint, Michigan 48532. This will be the only venue that potential contractors will be able to have a face-to-face conversation with both the Purchasing Department and WPC staff. This venue will also allow contractors to ask any questions concerning this Project. **Site tours will be scheduled with bidders during the virtual pre-bid meeting.** To receive an invitation to the virtual pre-bid meeting, please contact **Tiffany Harrison (ENGINEER)** at tharrison@wadetrim.com or **810.553.6541**.

Each bid proposal shall be submitted on the proposal forms provided and shall be accompanied by a certified check, cashier's check or bid bond, executed by the bidder and Surety Company, payable to Treasurer, City of Flint in the amount of five percent (5%) of the accompanying bid. Proposal Guarantee shall provide assurance that the bidder will, upon acceptance of the bid, execute the necessary Contract with the City. No bid may be withdrawn for one hundred twenty (120) days after scheduled closing time for receiving bids.

Proposals submitted by Bidders who have been debarred, suspended, or made ineligible by any Federal Agency will be rejected. The project is funded through the State Clean Water Revolving Loan program, requirements of the program are included in the Contract Documents.

Each bidder agrees to waive any claim it has or may have against the Owner, the Architect/Engineer, and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any bid.

The City of Flint reserves the right to reject all bids and to waive irregularities in bidding.

All additional bid documents, requirements, addendums, specifications and plans/drawings (if utilized) are available on the Purchasing page of the City of Flint's web site at <https://www.cityofflint.com/finance/purchasing/> under "open bids" and the specific bid or proposal number assigned to this notice.

Anticipated Bid Submission Schedule:

Date Released/Bid Posted to City's Website:	Friday, May 29, 2020
Bid Advertisement:	Monday, June 1, 2020
Virtual Mandatory Pre-bid Meeting:	Thursday, June 11, 2020 at 9:00 AM EST
In-Person Site Tour:	By Appointment
Final Date for Questions:	Thursday, June 25, 2020 at 5:00 PM EST
Final Addendum:	Friday, June 26, 2020 by 5:00 PM EST
Bid Due Date:	Wednesday, July 1, 2020 at 1:00 PM EST
Bid Review:	Friday, July 3, 2020
Introduce to Finance Committee:	Tuesday, July 8, 2020
Anticipated City Council Approval:	Monday, July 27, 2020
Anticipated Contract Execution:	Wednesday, August 26, 2020
Anticipated Notice to Proceed:	Wednesday, September 2, 2020

The dates provided above are estimated dates only and may be subject to change.

Submit to City:	One (1) printed, signed, original proposal and addenda
	Two (2) electronic copies of the proposal and addenda on flash drive
	One (1) printed, signed, copy of the proposal and addenda (unbound)

Send to:

The City of Flint
Department of Purchases and Supplies
1101 S. Saginaw Street, Room 203 Flint, MI 48502

Effective immediately upon release of these Bidding Documents, and until notice of contract award, all official communications from proposers regarding the requirements of this Bid shall be directed to:

Joyce A. McClane
810-766-7340
jmcclane@cityofflint.com

The City, or designee, shall distribute all official changes, modifications, responses to questions or notices relating to the requirements of this Bid. Addendum to this Bid may be developed and shared with all Vendors. Any other information of any kind from any other source shall not be considered official, and proposers relying on other information do so at their own risk.

Sincerely,

Joyce A. McClane, Purchasing Manager

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 City of Flint, a Municipal Corporation, and being a party of the first part of this Contract.
 - 4. The term "ENGINEER" means Wade Trim, Inc., 555 South Saginaw Street, Suite 201, Flint, Michigan 48502, or his duly authorized representative.
 - 5. The term "Issuing Office" means the office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

1.02 Copies of Bidding Documents

- A. Complete sets of the Bidding Documents may be obtained from the Issuing Office stated in the Advertisement for Bid or Invitation to Bid.
- B. Complete sets of Bidding Documents shall be used in preparing Bids; neither OWNER nor ENGINEER assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- C. OWNER and ENGINEER, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

1.03 Scope of Work

- A. The scope and location of Work are set forth in Section 01 1100, Summary of Work.

1.04 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 OWNER in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by OWNER to do so, shall furnish evidence, satisfactory to 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 (3) 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 OWNER that the Bidder is adequately prepared to fulfill the Contract.

1.05 Pre-Bid Conference

- A. A virtual mandatory Pre-Bid conference will be held Thursday, June 11, 2020, at 9:00 A.M., followed by an in-person tour at the City of Flint's Water Pollution Control (WPC) Facility, located at 4652 Beecher Road, Flint, MI 48532. Attendance at this meeting is required to submit a bid on the project. Site tours will be scheduled with WPC staff; one appointment per contractor or vendor.
- B. Representatives of OWNER and ENGINEER will be present to discuss the Project.
- C. Bidders are required to attend and participate in the conference.
- D. ENGINEER will transmit to all prospective Bidders a record of such Addenda as ENGINEER considers necessary in response to questions arising at the meeting. Oral statements made during the meeting may not be relied upon and will not be binding or legally effective.

1.06 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 Bidder 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 each Bidder will, at the Bidder's own expense, make such additional investigations and tests as the Bidder may deem necessary to determine 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 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 Section 01 1100, Summary of Work, or on the Plans.
- E. The locations of utilities as shown on the Plans are taken from sources believed to be reliable. Neither 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.
- 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.

1.07 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.

1.08 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.

1.09 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.

1.10 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.

1.11 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, 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 used as 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 Contract 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.

1.12 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.

1.13 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. The Contract shall be considered to have been awarded after the approval of OWNER has been duly obtained and a formal Notice of Award duly served on the successful Bidder by OWNER. The Contract shall not be binding upon OWNER until the Agreement has been duly executed by the Bidder and the duly authorized officials of OWNER.
- D. If the Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within 180 days after the day of the Bid opening, unless such other time is specified in the Advertisement for Bids.

1.14 Signing of Agreement

- A. Within 15 days after OWNER gives a Notice of Award to the successful Bidder, CONTRACTOR shall sign and deliver the specified number of counterparts of the Agreement to OWNER with all other Contract Documents attached. Within 10 days thereafter, OWNER will deliver 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.

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 American Iron and Steel Requirements

- A. CONTRACTOR acknowledges to and for the benefit of the City of Flint ("Purchaser") and the Michigan Department of Environmental Quality (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the State Revolving Fund and/or the Drinking Water Revolving Fund and such law contains provisions commonly known as "American Iron and Steel (AIS);" that requires all iron and steel products used in the project be produced in the United States ("AIS Requirements") including iron and steel provided by CONTRACTOR pursuant to this Agreement.
- B. CONTRACTOR hereby represents and warrants to and for the benefit of the Purchaser and the State that:
 - 1. CONTRACTOR has reviewed and understands the AIS Requirements:
 - 2. all iron and steel used in the project will be and/or have been produced in the United States in a manner that complies with the AIS Requirements, unless a waiver of the requirements is approved or the State made the determination in writing that the AIS Requirements do not apply to the project, and
 - 3. CONTRACTOR will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the AIS requirements, as may be requested by the Purchaser.
- C. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by CONTRACTOR shall permit the Purchaser or State to recover as damages against CONTRACTOR any loss, expense or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser).
- D. While CONTRACTOR has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and CONTRACTOR agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give these paragraphs force or effect) shall be amended or waived without the prior written consent of the State.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

**Section 00 4243
Proposal**

City of Flint
1101 S. Saginaw Street
Flint, Michigan 48502

Re: WPC Sludge Dewatering Improvements

The undersigned Bidder proposes and agrees, if this Proposal is accepted, to enter into an Agreement with the City of Flint (OWNER) 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:

TOTAL BASE CONTRACT PRICE	\$ _____ <i>(numeric)</i>
_____ <i>(In Words)</i>	

All specified cash allowances are included in the price(s) set forth above, and have been computed in accordance with Article 12.02 of the General Conditions.

1. Included in the Bid Price is an Allowance for SCADA programming and process integration in the amount of \$27,770.00 in accordance with Exhibit 2.
2. Included in the Bid Price is an Owner-Controlled Contingency Allowance in the amount of \$250,000.00.

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.

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 will be Substantially Completed within Four Hundred Twenty (420) calendar days after the Notice to Proceed has been issued and completed within Four Hundred and Eighty (480) calendar days of the Notice to Proceed has been issued.

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 one hundred twenty (120) 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: _____

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 the City of Flint, 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 4345 Legal Status of Bidder

This Proposal is submitted in the name of:

(Print) _____

The undersigned hereby designates below his business address to which all notices, directions or other communications may be served or mailed:

Street _____

City _____

State _____ Zip Code _____

The undersigned hereby declares that he has legal status checked below:

- ☐ SOLE PROPRIETOR
- ☐ SOLE PROPRIETOR DOING BUSINESS UNDER AN ASSUMED NAME
- ☐ CO-PARTNERSHIP
- The Assumed Name of the Co-Partnership is registered in the County of _____, Michigan
- ☐ CORPORATION INCORPORATED UNDER THE LAWS OF THE STATE OF _____ The Corporation is
- ☐ authorized to conduct business in the State of Michigan
- ☐ not now authorized to conduct business in the State of Michigan
- ☐ possess all required licenses for the work being bid
- ☐ limited liability corporation

The name, titles, and home addresses of all persons who are officers or partners in the organization are as follows:

NAME AND TITLE

HOME ADDRESS

Signed this _____ day of _____, 20____.

By _____ (Signature)

Printed Name of Signer _____

Title _____

Section 00 4546.13
Certification Regarding Debarment, Suspension and
Other Responsibility Matters

The prospective participant certifies, to the best of its knowledge and belief, that it and its principals:

- (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in transactions under federal non-procurement programs by any federal department or agency;
- (2) Have not, within the three-year period preceding the proposal, had one or more public transactions (federal, state, or local) terminated for cause or default; and
- (3) Are not presently indicted or otherwise criminally or civilly charged by a government entity (federal, state, or local) and have not, within the three-year period preceding the proposal, been convicted of or had a civil judgment rendered against it:
 - (a) For the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public transaction (federal, state, or local) or a procurement contract under such a public transaction;
 - (b) For the violation of federal or state antitrust statutes, including those proscribing prices fixing between competitors, the allocation of customers between competitors, or bid rigging; or
 - (c) For the commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

I understand that a false statement on this certification may be grounds for the rejection of this proposal or the termination of the award. In addition, under 18 U.S.C. §1001, a false statement may result in a fine of up to \$10,000 or imprisonment for up to five years, or both.

Name and Title of Authorized Representative

Name of Participant Agency or Firm

Signature of Authorized Representative

Date

☐ I am unable to certify to the above statement. Attached is my explanation.

Section 00 4539.13

Disadvantaged Business Enterprise (DBE)

Part 1 General

1.01 Summary

- A. Prime contractors bidding on this project must follow, document, and maintain documentation of their Good Faith Efforts, as listed below, to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project by increasing DBE awareness of procurement efforts and outreach. Bidders must make the following Good Faith Efforts for any work that will be subcontracted.
1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. Place DBEs on solicitation lists and solicit DBEs whenever they are potential sources.
 2. Make information on forthcoming opportunities available to DBEs. Arrange time-frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date. The DBEs should be given a minimum of 5 days to respond to the posting.
 3. Consider in the contracting process whether firms competing for large contracts can be subcontracted with DBEs. Divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
 4. Encourage contracting with a consortium of DBEs when a contract is too large for one DBE firm to handle individually.
 5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.
- B. Subsequent to compliance with the Good Faith Efforts, the following conditions also apply under the DBE requirements. Completed Good Faith Efforts Worksheets (Attachment 1), along with the required supporting documentation outlined in the instructions, must be submitted with your bid proposal. EPA form 6100-2 must also be provided at the pre-bid meeting. A copy of this form is available on the Forms and Guidance page of the Revolving Loan website.
1. The prime contractor must pay its subcontractor for work that has been satisfactorily completed no more than 30 days from the prime contractor's receipt of payment from the owner.
 2. The prime contractor must notify the owner in writing prior to the termination of any DBE subcontractor for convenience by the prime contractor and employ the Good Faith Efforts if soliciting a replacement contractor.
- If a DBE contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the Good Faith Efforts if soliciting a replacement contractor.
3. The prime contractor must employ the Good Faith Efforts.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

See next page for Attachment 1, Instructions, Frequently Asked Questions and DBE Subcontractor Participation Form.

Attachment 1

**Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance- Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET**

Bidder: _____

Subcontract Area of Work (one per worksheet: _____)

Outreach Goal: Solicit a minimum of three (3) DBEs via email/letter/fax. it is recommended that various sources be used to locate the minimum number of DBEs. The Michigan Department of Transportation (MDOT) website and www.sam.gov registries may be two resources used to find a minimum of three DBEs.

List the DBEs contacted for the above area of work and complete the following information for each DBE.

Company Name	Type of Contact	Date of Contact	Price Quote Received	Accepted/ Rejected	Please Explain if Rejected
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	

Explanation for Not Achieving a Minimum of Three Contacts; you may include a printout of the MDOT and www.sam.gov search results (attach extra sheets if necessary):

MITA DBE Posting Date (if applicable): _____
(attach a copy of the DBE advertisement)

Other Efforts (attach extra sheets if necessary): _____

Please include the completed worksheet and supporting documentation with the bid proposal.

Authorized under Parts 43 & 54 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

www.michigan.gov/deq

**Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance- Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET**

Instructions to Bidders for the Completion of the Good Faith Efforts Worksheet

1. Separate worksheets must be provided for each area of work to be subcontracted out. This includes both major and minor subcontracts.
2. A minimum of three (3) DBEs must be contacted by a verifiable means of communication such as e-mail, lever, or fax for each area of work to be subcontracted out. Copies of the solicitation letters/e-mails and fax confirmation sheets must be provided with the worksheet.
3. if less than three (3) DBEs exist statewide for the area of work, then provide documentation that other DBE resources were consulted. This may include the MOOT and www.sam.gov registries and an advertisement in a publication. A printout of the website searched (conducted prior to the end of the bid period) must be submitted.
4. Posting solicitations for quotes/proposals from DBEs on the MITA website (www.mitadb.com) is highly recommended to facilitate participation in the competitive process whenever possible. The solicitation needs to identify the project and the areas of work to be subcontracted out. A copy of the MITA DBE advertisement must be submitted with the Good Faith Efforts worksheet, if used, or a printout of the resulting quotes posted to the MITA website can be submitted with this form as supporting documentation.
5. If the area of work is so specialized that no DBEs exist, then an explanation is required to support that conclusion, including the documentation required in No. 3 above.
6. The date of the DBE contact must be identified, as it is important to document that the DBE solicitation was made during the bid period and that sufficient time was given for the DBE to return a quote.
7. Each DBE firm's price quote must be identified if one was received or N A entered on the worksheet if a quote was not received. Copies of all quotes must be submitted with the worksheet.
8. If a quote was received, indicate if it was accepted or rejected. Justification for not accepting a quote and not using the DBE subcontractor must be provided.
9. Under Other Efforts, please indicate additional steps you have taken to obtain DBE contractors and provide the appropriate supporting documentation such as:
 - Follow-up e-mails, faxes, or letters.
 - Copies of announcements/postings in newspapers, trade publications, or minority media that target DBE firms.

Rev. 3-2015

Authorized under Parts 43 & 54 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Disadvantaged Business Enterprise (DBE) Requirements Frequently Asked Questions Regarding Contractor Compliance

Q: What is the Good Faith Efforts Worksheet form and how is it to be completed?

A: This form captures efforts by the prime contractor to solicit DBEs for each area of work type that will be subcontracted out. A separate Good Faith Efforts Worksheet must be provided by the prime contractor for each area of work type to be subcontracted out. There are specific instructions that accompany this form that prescribe minimum efforts which bidders must make in order to be in compliance with the DBE requirements.

Q: Can non-certified DBEs be used?

A: While non-certified DBEs can be used, only DBEs, MBEs, and WBEs that are certified by EPA, SBA, or MOOT (or by tribal, state and local governments, as long as their standards for certification meet or exceed the standards in EPA policy) can be counted toward the fair share goal. Proof of certification by one of these recognized and approved agencies should be sought from each DBE.

Q: How does a DBE get certified?

A: Applications for certification under MOOT can be found at <http://mdotjboss.state.mi.us/UCP/LearnHowServ1et>

Applications for certification under EPA can be found on EPA's Small Business Programs website at http://www.epa.gov/osbp/dbe_firm.htm under Certification Forms.

Q: If a bidder follows the MOOT DBE requirements, will the bidder be in compliance with the SRF/DWRF DBE requirements?

A: No. Federally funded highway projects utilize DBE goals, which require that a certain percentage of work be performed by DBE subcontractors. For SRF/DWRF projects there is no financial goal. However, there is a solicitation effort goal. Bidders must use Good Faith Efforts for each and every area of work to be subcontracted out to obtain DBEs. The bidders are not required to use DBEs if the quotes are higher than non-DBE subcontractors. There is no required DBE participation percentage contract goal for the SRF/DWRF. However, if the SRF/DWRF project is part of a joint project with MOOT, the project can be excluded from SRF/DWRF DBE requirements (i.e., the Good Faith Efforts Worksheet is not required) as it would be difficult to comply with both programs' requirements.

Q: Must the Good Faith Efforts Worksheet and supporting documentation be turned in with the bid proposals?

A: Yes. This is a requirement to document that the contractor has complied with the DBE requirements and the Good Faith Efforts. These compliance efforts must be done during the bidding phase and not after-the-fact. It is highly recommended that the need for these efforts and the submittal of the forms with the bid proposals be emphasized at the pre-bid meetings. Failure to show that the Good Faith Efforts were complied with during the bidding process can lead to a prime contractor being found non-responsive.

Q: Does EPA form 6100-2 need to be provided at the pre-bid meeting?

A: Yes. The form must be made available at the pre-bid meeting.

Q: What kinds of documentation should a contractor provide to document solicitation efforts?

A: Documentation can include fax confirmation sheets, copies of solicitation letters/e-mails, printouts of online solicitations, printouts of online search results, affidavits of publication in newspapers, etc.

Q: How much time will compliance with the Good Faith Efforts require in terms of structuring an adequate bidding period?

A: Due to the extent of the efforts required, a minimum of 30 calendar days is recommended between bid posting and bid opening to ensure adequate time for contractors to locate certified DBEs and solicit quotes.

Q: How does a contractor locate certified DBEs?

A: The Michigan Department of Transportation has a directory of all Michigan certified entities located at <http://mdotjboss.state.mi.us/UCP/>. Additionally, the federal System for Award Management (SAM) is another place to search and can be found at www.sam.gov. SAM contains information from the former Central Contractor Registration (CCR) database.

Q: If the bidder does not intend to subcontract any work, what forms, if any, must be provided with the bid proposal?

A: The bidder should complete the Good Faith Efforts Worksheet with a notation that no subcontracting will be done. However, if the bidder is awarded the contract and then decides to subcontract work at any point, then the Good Faith Efforts must be made to solicit DBEs.

Q: In the perfect world, the Good Faith Efforts Worksheet is required to be turned in with the proposal. What if no forms are turned in with the bid proposal or forms are blank or incomplete? Should this be cause to determine that the bidder is non-responsive?

A: While the Good Faith Efforts Worksheet is important, it is more critical to confirm that the contractor complied with the DBE requirements prior to bid opening. The owner should contact the bidder as soon as deficiencies are noted for a determination/documentation of efforts taken to comply with the DBE requirements. Immediate submittal of the completed forms will be acceptable provided the Good Faith Efforts were made and it is just a matter of transferring information to the forms.

**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form**

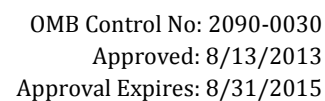
An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE¹ subcontractor² the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name		Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact	
Address			
Telephone No.		Email Address	
Prime Contractor Name		Issuing/Funding Entity:	

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services , Equipment or Supplies	Amount Received by Prime Contractor

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.



Please use the space below to report any concerns regarding the above EPA-funded project:

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Subcontractor Signature	Print Name
Title	Date

The public reporting and recordkeeping burden for this collection of information is estimated to average three (3) hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

Section 00 5100 Notice of Award

To: _____

Date: _____, 20____

Attention: _____

Project: WPC Sludge Dewatering Improvements

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders, you are hereby notified that the City of Flint (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.
555 S. Saginaw Street, Suite 201
Flint, MI 48502

(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 City of Flint 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:

This Project includes the partial demolition and renovation of an existing building at the Water Pollution Control Facility, including but not limited to partial demolition of an existing 1-story structure and the construction of a 1-story wall for the portion of the structure that is to remain; construction of a new exterior wall along with two (2) overhead doors; the partial demolition of a large bank of windows and the construction of an exterior wall to take their place; the construction of an interior wall to create a new and separate room for the proposed solids dewatering equipment and appurtenances; upgrades and/or modifications to the existing electrical system including demolition of existing panels, conduit, and wiring, as well as new panels, conduit and wiring; separation of the existing ventilation system and installation of a new ventilation system with BACnet network to interface with the WPCF's existing HVAC control system for the partitioned area; two (2) centrifuges including necessary piping, valves, pumps, motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; and a polymer feed system consisting of two (2) polymer skids, a 6,000-gallon HDPE storage tank, piping, valves, pumps, mixing system, filling station, instrumentation and SCADA controls; two (2) horizontal split-case pumps, including motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; connection to existing sludge piping and the construction of new sludge transfer lines to the proposed centrifuge equipment, including pipe, bends, fittings, and valves as well as instrumentation and SCADA controls.

ARTICLE 2. CONTRACT TIME

- 2.1 The Work will be substantially completed within Four Hundred Twenty (420) calendar days after the Notice to Proceed has been issued, and completed and ready for final payment in accordance with paragraph 14.11 of the General Conditions within Four Hundred and Eighty (480) calendar days after the Notice to Proceed has been issued.
- 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 **One Thousand Five Hundred Dollars (\$1,500.00)** 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 April 2020
- 6.8 Plans consisting of sheets dated April 2020 and with each sheet bearing the following general title: WPC Sludge Dewatering Improvements
- 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 _____

CONTRACTOR _____

By _____

By _____

Attest _____

Attest _____

Address for giving notices

Address for giving notices

License No. _____

Agent for service of process: _____

**Section 00 5500
Notice to Proceed**

To: _____

Date: _____, 20____

Attention: _____

Project: WPC Sludge Dewatering Improvements

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 _____, and _____, respectively, given the Work is to be completed within Four Hundred and Twenty (420) calendar days and Four Hundred and Eighty (480) calendar days after issuance of the Notice to Proceed, 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.
555 S. Saginaw Street, Suite 201
Flint, MI 48502

(OWNER)

By: _____
(Authorized Signature)

Section 00 6000 Project Forms

Part 1 General

1.01 Available Forms

- A. The following Project Forms are available for use by OWNER, CONTRACTOR and/or ENGINEER for this project and are located in Exhibit 1 of the Contract Documents:

1. Certificate of Substantial Completion
2. Change Order
3. Change Proposal
4. Construction Change Requisition / Work Change Directive
5. Field Order
6. Non-Compliance Notice / Order to Remove Defective Work
7. Open Items List
8. Punch List Items
9. Request for Final Inspection
10. Request for Information
11. Substitution Request Form
12. Warranty Data Sheet
13. City of Flint Material Disposal Form

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

**Section 00 6112
Performance Bond**

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, 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)

Attorney-In-Fact (Seal)

By _____

Address

Address of Surety

City Zip Code

City Zip Code

Telephone

Telephone

Section 00 6113
Labor and Material Payment Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, 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 6119
Maintenance & Guarantee Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, 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

NOW THEREFORE, the condition of this obligation is that under the Contract Documents, CONTRACTOR has agreed with OWNER that for a period of one (1) year from the date of payment of the Final Estimate, CONTRACTOR shall keep in good order and repair any defect in the Work, either by CONTRACTOR or its Subcontractors that may develop or be discovered during said one (1) year period due to improper materials, defective equipment, workmanship, or arrangements and any other work affected in making good such imperfections. CONTRACTOR also agreed to promptly make such repairs as directed by OWNER for replacement of the Work, without cost to OWNER, except for such parts of the Work as may have been disturbed without the consent of CONTRACTOR after the final acceptance of the Work, whenever directed so to do by notice from OWNER. If CONTRACTOR fails to make such repair within one (1) week from the date of receipt of such notice, then OWNER shall have the right to purchase such materials and employ such labor and equipment as may be necessary for the purpose and to undertake, to and make such repairs and charge the cost thereof to CONTRACTOR and receive payment for the same promptly from the CONTRACTOR or Surety.

If any repair is necessary to be immediately made to protect persons or property then, and in such event, OWNER may, but shall not be required to, take immediate steps to repair such defects without notice to CONTRACTOR. In such event, OWNER shall not be required to obtain the lowest bid for the performance of the Work or any part thereof, and all sums actually paid therefore shall be charged to the CONTRACTOR or Surety. In this regard, the judgment of OWNER shall be final and conclusive. CONTRACTOR shall, for a period of one (1) year from the date of payment of the Final Estimate, keep the Work in good order and repair, except for such parts of the Work which may have been disturbed without the consent of CONTRACTOR after the final acceptance of the Work. CONTRACTOR shall further, whenever notice is given as hereinbefore specified, promptly proceed to make the repair as in said notice directed or reimburse OWNER for any cost incurred by OWNER in making such repairs.

If CONTRACTOR or Surety shall fail to do as hereinbefore specified, they shall jointly and severally indemnify, defend, and hold harmless OWNER from and against all and any losses, costs, suits, and actions for damages of every kind and description brought or claimed against OWNER for or on account of any injury or damage to persons or property received or sustained by any party or parties by or from any of the acts of omissions or through the negligence of CONTRACTOR, its Subcontractors, Suppliers, servants, agents, or employees in connection with the Work and then from any and all claims arising under the Workmen's Compensation Act of the State of Michigan.

IN WITNESS WHEREOF, the parties hereto have caused this Maintenance and Guarantee Bond to be executed by their respective authorized officers this _____ day of _____, 20__.

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 6275
Engineer's Certificate for Payment

Job Number: _____ Certificate Number: _____ Date: _____

OWNER: _____

CONTRACTOR: _____

Project: _____

Contract Date: _____

Substantial Completion Date: _____ Extended To: _____

Completion Date: _____ Extended To: _____

Original Contract Price.....	Total Earned To Date.....
Adjustments to Quantities.....	Retention.....
Extras.....	Deductions.....
Total Change Orders.....	Total Withheld.....
Amended Contract Price.....	Total Net Due.....
Less Total Net Due.....	Less Previous Certificates.....
Balance on Contract.....	Total Balance Due this Certificate.....

ENGINEER'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on the data comprising the above application, the ENGINEER to the best of his knowledge, information, and belief and subject to the limitations stated in the Contract Documents certifies to the OWNER that: (1) Work has progressed to the point indicated, (2) that the quality of the Work is in accordance with the Contract Documents, and (3) the CONTRACTOR is entitled to payment of the Total Balance Due This Certificate.

Certified _____
ENGINEER Date

Recommended _____
Date

Section 00 6276
Contractor's Application for Payment

Job No. _____ Application No. _____ Date _____

OWNER: _____

CONTRACTOR: _____

Project: _____

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 6277 Payment Schedule

Job No. _____ Application No. _____ Date _____

Project: _____ Period: _____

Item of Work	Unit	Original Est. Quantity	Unit Price	Period Quantity	Period Amount	Total Quantity to Date	Total Amount to Date

Section 00 6325 Substitution Request Form

Specification Section # _____

Article # _____

Specified Product _____

Proposed Substitution _____

A.	Does specified product exceed, in any respect proposed substitution?	☐ Y ☐ N
B.	Does substitution affect dimensions shown on Plans?	☐ Y ☐ N
C.	Does substitution affect other trades more than original product?	☐ Y ☐ N
D.	Does warranty differ from that specified?	☐ Y ☐ N
E.	Does substitution affect cost to OWNER?	☐ Y ☐ N
F.	Does substitution result in any license fee or royalty?	☐ Y ☐ N

If you indicated "Yes" to any of the items above, attach thorough explanation on your Company letterhead, as follows:

1. Explain any differences between proposed substitution and specified product.
2. Summarize experience with product and manufacturer in Project area.
3. Attach complete technical data and literature.

The undersigned states that the function, appearance, and quality of the proposed substitution is equivalent or superior to the specified item, and that all information above and attached is true and correct.

Submitted by: _____ Date Submitted: _____

Company: _____

Address: _____

Telephone: _____ Fax: _____

Signature: _____

For use by ENGINEER

ENGINEER'S RESPONSE	RESPONSE REQUIRED OF CONTRACTOR
No Exceptions Taken ☐	None ☐
Note Markings ☐	Confirm ☐
Comments Attached ☐	Resubmit ☐
Rejected ☐	
Engineer's review is for general conformance with the design concept and contract documents. Markings or comments should not be construed as relieving the contractor from compliance with the project plans and specifications, nor departures therefrom. The contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner. By _____ Date _____	

(CONTINUED)

That the CONTRACTOR has not procured material from, or subcontracted with, any person other than those set forth on the reverse side and owes no money for the improvement other than the sums set forth on the reverse side.

Deponent further says that he or she makes the foregoing statement as the (CONTRACTOR) (Subcontractor) or as _____ of the (CONTRACTOR) (Subcontractor) for the purpose of representing to the OWNER or lessee of the described on the reverse side premises and his or her agents that the property described on the reverse side is free from claims of construction liens, or the possibility of construction liens, except as specifically set forth on the reverse side and except for claims of construction liens by laborers which may be provided pursuant to section 109 of the construction lien act, Act No. 497 of the Public Acts of 1980, as amended, being section 570.1109 of the Michigan Compiled Laws.

WARNING TO OWNER: AN OWNER OR LESSEE OF THE PROPERTY DESCRIBED ON THE REVERSE SIDE MAY NOT RELY ON THIS SWORN STATEMENT TO AVOID THE CLAIM OF A SUBCONTRACTOR, SUPPLIER, OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR A LABORER WHO MAY PROVIDE A NOTICE OF FURNISHING PURSUANT TO SECTION 109 OF THE CONSTRUCTION LIEN ACT TO THE DESIGNEE OR TO THE OWNER OR LESSEE IF THE DESIGNEE IS NOT NAMED OR HAS DIED.

(Deponent)

WARNING TO DEPONENT: A PERSON, WHO WITH INTENT TO DEFRAUD, GIVES A FALSE SWORN STATEMENT IS SUBJECT TO CRIMINAL PENALTIES AS PROVIDED IN SECTION 110 OF THE CONSTRUCTION LIEN ACT, ACT NO. 497 OF THE PUBLIC ACTS OF 1980, AS AMENDED, BEING SECTION 570.1110 OF THE MICHIGAN COMPILED LAWS.

Subscribed and sworn to before me this _____ day of _____, 20_____.

Notary Public

_____ County, Michigan

My Commission Expires _____

INSTRUCTIONS

1. A Sworn Statement in the preceding form must be provided before any CONTRACTOR or Subcontractor can file a Complaint, Cross-Claim, or Counter-Claim to enforce a construction lien.
2. An OWNER or lessee may withhold payment to a CONTRACTOR or Subcontractor who has not provided a Sworn Statement. An OWNER or lessee may withhold from a CONTRACTOR or Subcontractor who has provided a Sworn Statement the amount sufficient to pay all sums shown on the statement as owing Subcontractors, Suppliers, and laborers, or the amount shown to be due to lien claimants who have provided Notices of Furnishing pursuant to the Construction Lien Act of 1980.
3. An OWNER or lessee may rely on a Sworn Statement to avoid a lien claim unless the lien claimant has provided the OWNER or lessee with a Notice of Furnishing pursuant to the Construction Lien Act of 1980.
4. If the contract provides for payments by the OWNER to the general contractor, if any, in the normal course of construction, but the OWNER elects to pay lien claimants directly, the first time the OWNER elects to make payment directly to a lien claimant he or she shall provide at least 5 business days' notice to the general contractor of the intention to make direct payment. Subsequent direct disbursements to lien claimants need not be preceded by the 5-day notice provided in this section unless the OWNER first returns to the practice of paying all sums to the general contractor.

Section 00 6521

Prevailing Federal Wage Rate – Davis Bacon Act

Part 1 General

1.01 Summary

- A. P.L. 111-88 requires compliance with the Davis Bacon Act and adherence to the current U.S. Department of Labor Wage Decision. Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Contract Documents (see Wage Decision included herein) must be paid on this project. The Wage Decision, including modifications, must be posted by the Contractor on the job site. A copy of the Federal Labor Standards Provisions is included and is hereby a part of this contract.
- B. In case there is an omission of any trade from the list of wage and fringe benefit rates to be paid to each class of mechanic by CONTRACTOR, it shall be understood that the trades omitted shall also be paid not less than the wage and fringe benefit rates prevailing in the locality in which the work is to be performed.
- C. A finding by the U.S. Department of Labor's Wage and Hour Division that CONTRACTOR or subcontractor is in violation of the requirements of the contract shall be final.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

See Next Page for Wage Rate Determination.

"General Decision Number: MI20200083 05/08/2020

Superseded General Decision Number: MI20190083

State: Michigan

Construction Type: Building

County: Genesee County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.80 for calendar year 2020 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.80 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 calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	01/24/2020
2	05/08/2020

ASBE0047-002 07/01/2019

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 31.82	17.88

BOIL0169-001 03/01/2018

	Rates	Fringes
BOILERMAKER.....	\$ 38.65	26.22

BRMI0009-014 08/01/2019

	Rates	Fringes
BRICKLAYER.....	\$ 33.23	21.28
TILE FINISHER.....	\$ 29.93	18.02
TILE SETTER.....	\$ 29.93	18.02

FOOTNOTE:

Paid Holiday: Fourth of July, if the worker was employed by the contractor in any period of seven working days before said holiday within the current calendar year.

CARP0706-001 06/01/2019

	Rates	Fringes
CARPENTER, Includes		
Acoustical Ceiling		
Installation, Drywall		
Hanging, Form Work, and Metal		
Stud Installation.....	\$ 27.21	21.54

ELEC0948-001 11/25/2019

	Rates	Fringes
ELECTRICIAN		
Excludes Low Voltage Wiring.	\$ 38.31	23.06
Low Voltage Wiring.....	\$ 29.46	17.12

ENGI0324-011 06/01/2019

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 39.58	24.35
GROUP 2.....	\$ 36.28	24.35
GROUP 3.....	\$ 33.63	24.35
GROUP 4.....	\$ 31.92	24.35
GROUP 5.....	\$ 31.92	24.35
GROUP 6.....	\$ 26.06	24.35
GROUP 7.....	\$ 23.58	24.35

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: Backhoe/Excavator/Trackhoe; Bulldozer; Concrete Pump; Crane; Grader/Blade; Highlift; Hoist; Loader; Roller; Scraper; Stiff Leg Derrick; Tractor; Trencher

GROUP 4: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 5: Boom Truck (non-swinging)

GROUP 6: Fork Truck (20' lift and under for masonry work)

GROUP 7: Oiler

IRON0025-019 06/01/2019

	Rates	Fringes
IRONWORKER		
REINFORCING.....	\$ 30.98	27.99
STRUCTURAL.....	\$ 36.77	29.03

LAB00334-005 06/01/2019

	Rates	Fringes
LABORER: Landscape & Irrigation		
GROUP 1.....	\$ 20.75	7.10
GROUP 2.....	\$ 18.75	7.10

CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer, skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

LAB01075-002 06/01/2019

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Brick/Cement/Concrete, Pipelayer; Sandblaster.....	\$ 23.00	13.66

PAIN1052-001 06/01/2018

	Rates	Fringes
PAINTER		
Brush & Roler.....	\$ 24.40	12.95
Spray.....	\$ 25.75	12.95

PAIN1052-004 06/01/2018

	Rates	Fringes
DRYWALL FINISHER/TAPER		
Drywall sanding.....	\$ 26.07	13.50
Hand work.....	\$ 26.07	13.50
Machine work.....	\$ 26.07	13.50

PLAS0016-005 04/01/2014

	Rates	Fringes

CEMENT MASON/CONCRETE FINISHER...\$ 25.58 12.88

PLUM0370-002 06/01/2018

Rates Fringes

PIPEFITTER (Includes HVAC
Pipe Installation; Excludes
HVAC System Installation).....\$ 37.81 20.60
PLUMBER, Excludes HVAC Pipe
Installation.....\$ 37.81 20.60

ROOF0149-005 06/01/2019

Rates Fringes

ROOFER.....\$ 28.53 17.53

* SFMI0669-001 04/01/2020

Rates Fringes

SPRINKLER FITTER (Fire
Sprinklers).....\$ 35.72 23.60

SHEE0007-008 05/01/2018

Rates Fringes

SHEET METAL WORKER, Includes
HVAC Duct and Unit
Installation.....\$ 30.64 22.76

SUMI2011-008 02/01/2011

Rates Fringes

IRONWORKER, ORNAMENTAL.....\$ 18.48 7.93

TRUCK DRIVER: Tractor Haul
Truck.....\$ 13.57 1.18

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

=====

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 www.dol.gov/whd/govcontracts.

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 Regional Office for the area in which the survey was conducted because those Regional Offices have 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 DECISION"

Superseded General Decision Number: MI20190157

State: Michigan

Construction Type: Heavy
PIPELINE

Counties: Michigan Statewide.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.80 for calendar year 2020 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.80 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 calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	05/08/2020

* ENGI0325-012 05/01/2020

	Rates	Fringes
Power equipment operators - gas distribution and duct installation work:		
GROUP 1.....	\$ 32.18	24.85
GROUP 2.....	\$ 32.06	24.85
GROUP 3.....	\$ 30.35	24.85

SCOPE OF WORK: The construction, installation, treating and reconditioning of pipelines transporting gas vapors within cities, towns, subdivisions, suburban areas, or within private property boundaries, up to and including private meter settings of private industrial, governmental or other premises, more commonly referred to as ""distribution work,"" starting from the first metering station, connection, similar or related facility, of the main or cross country pipeline and including duct installation.

Group 1: Backhoe, crane, grader, mechanic, dozer (D-6 equivalent or larger), side boom (D-4 equivalent or

larger), trencher(except service), endloader (2 yd. capacity or greater).

GROUP 2: Dozer (less than D-6 equivalent), endloader (under 2 yd. capacity), side boom (under D-4 capacity), backfiller, pumps (1 or 2 of 6-inch discharge or greater), boom truck (with powered boom), tractor (wheel type other than backhoe or front endloader). Tamper (self-propelled), boom truck (with non-powered boom), concrete saw (20 hp or larger), pumps (2 to 4 under 6-inch discharge), compressor (2 or more or when one is used continuously into the second day) and trencher(service).

GROUP 3: Oiler, hydraulic pipe pushing machine, grease person and hydrostatic testing operator.

LAB01076-005 04/01/2019

MICHIGAN STATEWIDE

	Rates	Fringes
LABORER (DISTRIBUTION WORK)		
Zone 1.....	\$ 21.47	12.90
Zone 2.....	\$ 19.77	12.90
Zone 3.....	\$ 17.95	12.90
Zone 4.....	\$ 17.32	12.90
Zone 5.....	\$ 17.30	12.90

DISTRIBUTION WORK - The construction, installation, treating and reconditioning of distribution pipelines transporting coal, oil, gas or other similar materials, vapors or liquids, including pipelines within private property boundaries, up to and including the meter settings on residential, commercial, industrial, institutional, private and public structures. All work covering pumping stations and tank farms not covered by the Building Trades Agreement. Other distribution lines with the exception of sewer, water and cable television are included.

Underground Duct Layer Pay: \$.40 per hour above the base pay rate.

Zone 1 - Macomb, Oakland and Wayne

Zone 2 - Monroe and Washtenaw

Zone 3 - Bay, Genesee, Lapeer, Midland, Saginaw, Sanilac, Shiawassee and St. Clair

Zone 4 - Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon and Schoolcraft

Zone 5 - Remaining Counties in Michigan

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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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 www.dol.gov/whd/govcontracts.

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).

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END OF GENERAL DECISION"

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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 5 copies 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 Order 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"

- A. 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.
- D. 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 or 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.
- E. The 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 the ENGINEER through CONTRACTOR.
- F. 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 the 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.

- G. 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. The 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, expeditors, 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 13.09, 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-4.02 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:

Copies of the following reports and/or tests are attached as Exhibits:

Exhibit 2 - Geotechnical Report titled "Geotechnical Exploration, Proposed Dewatering Building, Flint Wastewater Treatment Plant" dated February 18, 2018, prepared by Geotrans, consisting of 31 pages with 2 boring logs. The "technical data" contained in such report upon which CONTRACTOR may rely is the boring logs and report.

SGC-5.03.D Additional Insured

Add the following language at the end of Article 5.03.D. of the General Conditions:

The name insured on OWNER's and CONTRACTOR's Protective Policy shall be: The City of Flint

Additional named insured on OWNER's and CONTRACTOR's Protective Policy shall include:

1. Wade Trim, Inc.
2. Hubbell, Roth & Clark, Inc.
3. Osborn Engineering

SGC-5.04 Limits of Liability

The required limits of liability for insurance coverages requested in Section 5.03 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	\$2,000,000
Products – Com/Ops Aggregate	\$2,000,000
Personal and Advertising Injury	\$1,000,000
Each Occurrence	\$1,000,000
Fire Damage (any one fire)	\$ 50,000
Medical Expense (any one person)	\$ 5,000

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury	\$1,000,000
Property Damage	\$1,000,000
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.F. Umbrella or Excess Liability

Each Occurrence	\$2,000,000
Aggregate	\$2,000,000

SGC-18 Dispute Resolution

Dispute resolution, if applicable, are referenced in the General Conditions. The requirements for dispute resolution should be included herein:

Article 18 Dispute Resolution**18.01 Methods and Procedures**

- A. Either OWNER or CONTRACTOR may request mediation of any Claim submitted to ENGINEER for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 11.01.
- B. OWNER and CONTRACTOR shall participate in the mediation process in good faith. The process shall be concluded within sixty (60) days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, ENGINEER's action under Paragraph 11.01 or a denial pursuant to Paragraphs 11.01 shall become final and binding 30 days after termination of the mediation unless, within that time period, OWNER or CONTRACTOR:
 - 1. elects in writing to demand arbitration of the Claim, pursuant to Paragraph 18.02; or
 - 2. agrees with the other party to submit the Claim to another dispute resolution process.

18.02 Arbitration

- A. Claims or counterclaims, disputes, or other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.01) including but not limited to those not resolved under the provisions of Paragraphs 18.01 will be decided by arbitration in accordance with the rules of the American Arbitration Association, subject to the conditions and limitations of this Paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the 30-day period specified in Paragraph 18.01, and in all other cases within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statute of limitations.
- C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder, or in any other manner any other individual or entity (including ENGINEER, and ENGINEER's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
 - 1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and
 - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.
- D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include:
 - 1. a concise breakdown of the award;
 - 2. a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.
- E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Controlling Law relating to vacating or modifying an arbitral award.
- F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by OWNER and CONTRACTOR.

SGC-19 Liquidated Damages

Liquidated damages, if applicable, are referenced in the Proposal and Agreement. The requirements for liquidated damages should be included herein.

Article 19 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.

End of Section

Division 01
General Requirements

Section 01 1100

Summary of Work

Part 1 General

1.01 Work Covered by Contract Documents

- A. This Project includes the partial demolition and renovation of an existing building at the Water Pollution Control Facility, including but not limited to partial demolition of an existing 1-story structure and the construction of a 1-story wall for the portion of the structure that is to remain; construction of a new exterior wall along with two (2) overhead doors; the partial demolition of a large bank of windows and the construction of an exterior wall to take their place; the construction of an interior wall to create a new and separate room for the proposed solids dewatering equipment and appurtenances; upgrades and/or modifications to the existing electrical system including demolition of existing panels, conduit, and wiring, as well as new panels, conduit and wiring; separation of the existing ventilation system and installation of a new ventilation system with BACnet network to interface with the WPCF's existing HVAC control system for the partitioned area; two (2) centrifuges including necessary piping, valves, pumps, motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; and a polymer feed system consisting of two (2) polymer skids, a 6,000-gallon HDPE storage tank, piping, valves, pumps, mixing system, filling station, instrumentation and SCADA controls; two (2) horizontal split-case pumps, including motor starters, variable frequency drives, programmable logic controllers, instrumentation and SCADA controls; connection to existing sludge piping and the construction of new sludge transfer lines to the proposed centrifuge equipment, including pipe, bends, fittings, and valves as well as instrumentation and SCADA controls.

1.02 Work by Others

- A. While there is no other work in the immediate Project area there will be several construction projects that will be underway during the same period as this Work. This CONTRACTOR shall therefore coordinate with OWNER and other contractors onsite in order to minimize disruption to this Work.

1.03 CONTRACTOR's Use of Premises

- A. CONTRACTOR shall maintain his construction operations within the presently existing road rights-of-way and easements throughout the Project area. In the event that CONTRACTOR deems it necessary or advisable to operate beyond the limits of the existing rights-of-way or easements, he shall be responsible for making special written agreements with the property owners and shall furnish such copies of agreement to OWNER.

1.04 Photographs

- A. Photographs, as specified in Section 01 3300, Submittal Procedures, shall be required for this Project.

1.05 Audio/Video Route Survey

- A. An audio/video route survey, as specified in Section 01 3300, Submittal Procedures, shall be required for this Project. Complete coverage shall include the area inside and immediately adjacent to the building being renovated, including but not limited to:
 - 1. Exterior of the existing building, including the south and east sides of the building;

2. Interior of the 1-story portion of the existing building to be demolished;
 3. Interior of the building that will be partitioned;
 4. Basement where connections to the existing sludge piping are to be constructed, as well as the path of the new piping to be constructed/existing piping to be demolished; and
 5. Basement where new water pumps are to be installed.
- B. The audio/video route survey shall be delivered to ENGINEER on a USB drive. CONTRACTOR shall submit a minimum of two (2) copies of the survey.

1.06 Engineer's Field Office

- A. A Field Office, as specified in Section 01 5000, Temporary Facilities and Controls, shall be required for this Project.

1.07 Project Sign

- A. A project sign, as shown in the Contract Documents, shall be required for this Project. CONTRACTOR shall furnish, install, maintain, and disassemble at project completion a project sign. Costs for this Work will be incidental to the Project.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 2100 Allowances

Part 1 General

1.01 General

- A. CONTRACTOR shall include in his/her Bid the Allowance(s) listed in the Bid Proposal. These Allowances shall cover work, manufactured equipment or services that will be provided either by CONTRACTOR or by others who may be selected by OWNER.
- B. Work performed under Allowances shall be subject to OWNER approval and under special terms described herein. CONTRACTOR shall coordinate and cause the work covered by these Allowances.
- C. 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.

1.02 Requirements

- A. Allowances shall be administered in accordance with the provisions of the General Conditions of the Contract. CONTRACTOR shall be required to coordinate this work with the agency involved and pay all costs the agency may charge in connection with this work.
- B. Thereafter, if the actual price for this work is more or less than the allowance, the Contract Price shall be adjusted accordingly by Change Order. The adjustment in Contract Price shall be made on the basis of the actual invoice price without additional charge or markups for overhead, insurances, bonds, or any other incidental expenses.
- C. CONTRACTOR shall be responsible for all coordination with the agency involved and for the timely completion of the Work to fit his schedule. CONTRACTOR shall not be allowed any additional compensation for the failure of the agency involved to meet any schedule.

1.03 Definitions

- A. Lump Sum Allowance: A monetary sum that includes, as part of the Contract Price, the associated costs and requirements to complete the specified Allowance.
- B. Owner-Controlled Change Allowance: A monetary sum that is, as part of the Contract Price, the sole use of OWNER to cover unanticipated costs and will be used only under the direction of OWNER.

1.04 Submittals

- A. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the Site for use in fulfillment of each Allowance.

1.05 Instructions

- A. At the earliest feasible date after Contract Award, CONTRACTOR shall advise ENGINEER of the date when the final selection and purchase of each product or system described by an Allowance must be completed in order to avoid delay in performance of the work.

- B. When requested by ENGINEER, CONTRACTOR shall obtain Bids for each Allowance for use in making final selections; include recommendations that are relevant to performance of the Work.
- C. CONTRACTOR shall purchase products and systems as selected by ENGINEER from the designated Supplier.
- D. Allowances shall be used only as directed for OWNER's purposes, and only by Change Orders which designate amounts to be charged to the Allowance.
- E. If the actual price for the specified Allowance is more or less than the stated Allowance, the Contract Price shall be adjusted accordingly by Change Order. The adjustment in Contract Price shall be made in accordance with the General Conditions.
- F. At Project closeout, any amounts remaining in Allowances will be credited to OWNER by Change Order.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 2513 Substitution Procedures

Part 1 General

1.01 Section Includes

- A. Options for making product or process selections.
- B. Procedures for proposing equivalent construction products or processes, including preapproved, prequalified, and approved products or processes.

1.02 Definitions

- A. Product: Means materials, equipment, or systems incorporated into the Project. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for reuse.
- B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Product includes Processes.

1.03 Selection Options

- A. Preapproved Products: Construction products of certain manufacturers or suppliers designated in the Specifications as "preapproved." A list of preapproved products is maintained by OWNER. Preapproved products for this Project are designated as preapproved in the Specifications. Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.
- B. Prequalified Products: Construction products of certain manufacturers or suppliers designated in the Specifications as "prequalified." Prequalified products for this Project are designated as prequalified in the Specifications. Products of other manufacturers or suppliers will not be acceptable for this Project and will not be considered under the submittal process for approving alternate products.
- C. Approved Products: Construction products or processes of certain manufacturers or suppliers designated in the Specifications followed by the words "or approved equal." Approval of alternate products or processes not listed in the Specifications may be obtained through provisions for product options and substitutions in Section 00 7200, General Conditions, and by following the submittal procedures specified in Section 01 3300, Submittal Procedures. The procedure for approval of alternate products is not applicable to preapproved or prequalified products.
- D. Product Compatibility: To the maximum extent possible, provide products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available as a CONTRACTOR's option, select a product which is compatible with other products already selected, specified, or in use by OWNER.

1.04 CONTRACTOR's Responsibility

- A. CONTRACTOR's responsibility related to product options and substitutions is defined in Section 00 7200, General Conditions.

- B. Complete the Substitution Request Form provided in Section 00 6325 and furnish information ENGINEER deems necessary to judge equivalency of the alternate product.
- C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish the equivalency between products in order to obtain information upon which ENGINEER can base a decision.
- D. If ENGINEER determines that an alternate product is not equal to that named in the Specifications, CONTRACTOR shall furnish one of the specified products.

1.05 Engineer's Review

- A. Alternate products or processes may be used only if approved in writing by ENGINEER. ENGINEER's determination regarding acceptance of a proposed alternate product is final.
- B. Alternate products will be accepted if the product is judged by ENGINEER to be equivalent to the specified product or to offer substantial benefit to OWNER.
- C. OWNER retains the right to accept any product or process deemed advantageous to OWNER, and similarly, to reject any product or process deemed not beneficial to OWNER.

1.06 Substitution Procedure

- A. Collect and assemble technical information applicable to the proposed product to aid in determining equivalency as related to the approved product specified.
- B. Submit a written request for a construction product to be considered as an alternate product.
- C. Submit the product information after the effective date of the Agreement and within the time period allowed for substitution submittals given in Section 00 7200, General Conditions. After the submittal period has expired, requests for alternate products will be considered only when a specified product becomes unavailable because of conditions beyond CONTRACTOR's control.
- D. Submit six (6) copies of each request for alternate product approval. Include the following information:
 - 1. Complete data substantiating compliance of proposed substitution with Contract Documents.
 - 2. For products:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature with product description, performance and test data, and reference standards.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product was used and date of installation. Include the name of OWNER, ENGINEER, and CONTRACTOR.

3. For construction methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 4. Itemized comparison of proposed substitution with product or method specified.
 5. Data relating to changes in construction schedule.
 6. Relation to separate contracts, if any.
 7. Accurate cost data on proposed substitution in comparison with product or method specified.
 8. Other information requested by ENGINEER.
- E. Approved alternate products will be subject to the same review process as the specified product would have been for shop drawings, product data, and samples.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 3119 Project Meetings

Part 1 General

1.01 Preconstruction Meeting

- A. Prior to the delivery of materials or the start of any construction, CONTRACTOR shall request a Preconstruction Meeting from ENGINEER. A minimum three (3) working days' notification to meeting participants shall be required.
- B. Schedule:
 - 1. ENGINEER will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. CONTRACTOR shall notify major Subcontractors.
- C. Attendance:
 - 1. OWNER
 - 2. ENGINEER
 - 3. CONTRACTOR
 - 4. Major Subcontractors
 - 5. Utility Companies
 - 6. Safety Representatives
 - 7. Governmental Agencies
- D. Agenda:
 - 1. Distribution by CONTRACTOR and discussion, review and acceptance of:
 - a. List of names and telephone numbers for superintendent, foreman and other key personnel.
 - b. List of major Subcontractors and Suppliers.
 - c. Projected construction preliminary progress schedules.
 - d. Preliminary schedule of Shop Drawings and Sample submittals.
 - e. Estimated monthly payment schedule and schedule of values
 - 2. Critical Work sequencing.
 - 3. Major equipment deliveries and priorities.
 - 4. Project coordination.
 - 5. Responsibilities of OWNER, ENGINEER, CONTRACTOR and other agencies.
 - 6. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals.
 - d. Change Orders.
 - e. Applications for Payment.

7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining Record Documents.
9. Use of premises.
10. Construction facilities, controls and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.
15. Testing

E. Minutes:

1. ENGINEER will prepare and distribute copies to participants within seven (7) days of meeting. Participants shall report corrections and comments within ten (10) days of receipt of minutes.

1.02 Progress Meetings

A. Periodic Progress Meetings will be held as required by the progress of the Work.

B. Schedule:

1. ENGINEER will establish the meeting place, time and date, distribute agenda, notify participants and administer the meeting. CONTRACTOR shall notify major Subcontractors.

C. Attendance:

1. OWNER
2. ENGINEER
3. CONTRACTOR
4. Subcontractor as appropriate to the agenda.
5. Suppliers as appropriate to the agenda.
6. Others

D. Agenda:

1. Review minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Review field observations, problems, conflicts.
4. Review problems which impede Construction Schedules.
5. Review of off-site fabrication, delivery schedules.
6. Review corrective measures and procedures to regain projected schedule.
7. Review revisions to Construction Schedules.
8. Review plan progress, schedule, during succeeding Work period.
9. Review coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Review maintenance of quality standards.
12. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other Contracts of the Project.
13. Other business.

- E. Minutes:
 - 1. ENGINEER will prepare and distribute copies to participants and OWNER within seven (7) days of meeting for review at the next meeting.

1.03 Preinstallation Meeting

- A. When required in individual specification sections, CONTRACTOR convene a preinstallation meeting at the Site prior to commencing work of the section.
 - 1. Notify OWNER and ENGINEER four (4) days in advance of meeting date.
- B. CONTRACTOR shall require the attendance of parties directly affecting, or affected by, Work of the specific section.
- C. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- D. CONTRACTOR shall record and distribute copies of meeting minutes within two (2) days after meeting to participants, with copies to ENGINEER, OWNER, participants, and those affected by decisions made.

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 Schedule for Submission

- A. Prior to submitting any shop drawings, product data, portfolios, samples, etc. CONTRACTOR shall prepare a summary listing all items in the project which will be submitted for review by ENGINEER.
- B. The summary shall be submitted within twenty (20) calendar days after receipt of Notice to Proceed and shall be updated once per month thereafter.
- C. The summary shall include the proposed dates for submittal for each item for control purposes. The summary shall be prepared in coordination with the Project Schedule, allowing adequate time for review by ENGINEER and possible resubmittal by CONTRACTOR.
- D. The summary and schedule for submittals shall not relieve CONTRACTOR of his obligation to comply with specification requirements for items not listed on the Project Schedule.
- E. Nothing herein shall be construed as allowing additional time for completion of the project in the event resubmittal is required for shop drawings or the other items to be submitted.

1.03 Submission Requirements

- A. 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. CONTRACTOR shall transmit each submittal with an ENGINEER-approved transmittal form.
- B. Schedule submittals to expedite the Project and deliver to ENGINEER in a manner to allow sufficient time for review and processing by ENGINEER so as to not cause delays in the Work. CONTRACTOR shall coordinate submission of related items.
- C. Drawings, information and documentation shall be prepared and submitted with all words in the English language and dimensions in American units; no foreign language or metric units will be permitted.
- D. Identify variations from Contract Documents and Products and system limitations which may be detrimental to successful performance of the completed Work.
- E. Distribute copies of reviewed submittals to all concerned and related parties. Instruct parties to promptly report any inability to comply with provisions.
- F. ENGINEER reserves the right to refuse to check or review any submittal of a Subcontractor, Supplier or manufacturer which is not presented in compliance with the foregoing requirements.

- G. Each submittal shall:
1. Be sequentially number the transmittal form. Re-submittals shall have original number and a sequential alphabetic suffix.
 2. Identify Project, CONTRACTOR, Subcontractor and supplier; pertinent drawing and detail number, and specification section number, as appropriate.
 3. Have CONTRACTOR's stamp that has been initialed or signed, 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.
- H. Electronic Submittals:
1. Electronic submittals shall follow the procedures outlined above.
 2. Electronic submittal procedures are only applicable to Shop Drawings and product data submittals.
 3. Electronic submittals shall be made in a standard format ENGINEER has agreed in advance to accept, JPEG, TIF, DGN, DXF, DWG, or PDF.
 4. Reviewed submittals shall be returned in JPEG, TIF, or PDF electronic format for CONTRACTOR's printing and distribution.

1.04 Submittal Review

- A. Subcontractors, Suppliers and manufacturers' submittals shall first be sent directly to CONTRACTOR, who shall keep a record of the submittal numbers and the dates of receipt. CONTRACTOR shall check thoroughly the submittal in regard to measurements, sizes of members, materials, and other details to assure CONTRACTOR that they conform to the intent of the drawings and the specification, and shall promptly return to the Subcontractors, Suppliers and/or manufacturers for correction such submittals as are found inaccurate or otherwise in error.
- B. ENGINEER will review the submittal within a reasonable time after receipt thereof and will return one (1) copy (unless otherwise specified), endeavoring to indicate, by notation thereon or written instructions, any correction which may be necessary to meet the Contract requirements.
1. CONTRACTOR shall then review such notations and/or instructions and if CONTRACTOR concurs therein, shall make or have made such required corrections, and shall, when so noted on submittals or requested by ENGINEER, resubmit corrected submittals to ENGINEER as soon as possible, for final review.
 2. Such further review by ENGINEER will be limited to the corrections only, and CONTRACTOR, by such re-submission shall be held to have represented that such submittals contain no other alterations, additions or deletions, unless CONTRACTOR (in writing) directs ENGINEER 's specific attention to same.
 3. Should CONTRACTOR question, or dissent from, such notations and/or instructions, CONTRACTOR shall so inform ENGINEER and request further clarification before resubmitting submittals.

- C. Review of submittals by ENGINEER is for coordination and assistance, and ENGINEER does not thereby assume responsibility for errors or omissions. Such errors or omissions must be made good by CONTRACTOR, irrespective of the receipt, review of the submittals by ENGINEER, and even though the Work is done in accordance with such submittals.

1.05 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.

1.06 Progress Schedules

- A. CONTRACTOR shall submit a copy of each Progress Schedule indicating the starting and completion dates of the various stages of the Work and estimated payments during the next 3 months to ENGINEER.
 - 1. Proposed Progress Schedules shall be submitted to ENGINEER prior to the preconstruction meeting.
 - 2. CONTRACTOR shall distribute copies of the Progress Schedules during the preconstruction meeting for discussion.
 - 3. Progress Schedules shall be updated by CONTRACTOR and submitted 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.

1.07 Shop Drawing Schedule

- A. CONTRACTOR shall submit a copy of each Shop Drawing Schedules indicating the individual items and submission dates to ENGINEER.
 - 1. A preliminary Schedule in accordance with the requirements in the General Conditions shall be submitted by CONTRACTOR prior to the preconstruction meeting.
 - 2. Copies of this preliminary Schedule shall be made available by CONTRACTOR during the preconstruction meeting.
 - 3. A final Schedule shall be submitted by CONTRACTOR at least ten (10) days prior to submitting the first Application for a Payment.

1.08 Schedule of Values

- A. CONTRACTOR, if applicable, shall a copy of the Schedule of Value of the Work to ENGINEER.
 - 1. A preliminary Schedule of Values shall be submitted by CONTRACTOR prior to the preconstruction meeting.
 - 2. A final Schedule of Values, 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 approval at least ten (10) days prior to submitting the first Application for Payment.

1.09 Staking Schedule

- A. CONTRACTOR shall submit a copy 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.

1.10 Applications for Payment

- A. CONTRACTOR shall submit 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/Declaration, Payment Schedule and ENGINEER's Certificate forms for this purpose are included in the Contract Documents.
- 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.

1.11 Shop Drawings

- A. Shop Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to Plan Sheet Number and Detail, and Specification Section Number and Page Number.

1.12 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.

1.13 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.

1.14 Specification Section Requirements

- A. Miscellaneous schedules, field reports, test reports, affidavits, certificates, permits, agreements and other items identified in the Specification Sections, or as requested by ENGINEER shall be submitted to ENGINEER.

- B. As a minimum, these submittals should be identified with the Project title, date of submission, and Specification section reference.

1.15 Manufacturer Installation Instructions

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation and start-up to ENGINEER in quantities specified for Product Data.
- B. Identify conflicts between manufacturer's instructions and Contract Documents.

1.16 Manufacturer Certificates

- A. When specified in individual sections, submit certification by manufacturer to ENGINEER in quantities specified for Product Data.
- B. Indicate material or Product meets or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to ENGINEER.

1.17 Manufacturer's Operation and Maintenance Data

- A. CONTRACTOR shall furnish four (4) copies 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. 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.

1.18 Photographs

- A. When required in the Summary of Work, Section 01 1100, CONTRACTOR shall furnish ENGINEER a minimum of four (4) color digital photographs each month during construction of the Project. All photographs shall be taken at such times and of such views as ENGINEER directs.
- B. The following information shall be placed on the back of the photos: job name, contract number, description of view and date of photograph. CONTRACTOR shall submit photographs monthly along with the Application for progress Payment as described in Article 14 of the General Conditions.

1.19 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 preconstruction meeting.
- C. Format:
 - 1. Audio/Video route survey shall be submitted in the format(s) as specified in Section 01 1100, Summary of Work.
 - a. Audio/video route survey submission shall be on media meeting the following specifications:
 - (1) Media: USB
 - (2) Format: 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. When conventional wheeled vehicles are used, distance from the camera lens to the ground shall be not less than 12 feet (3.5 m) to ensure proper perspective. 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.

- E. Video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information to include the date and time of recording, as well as the corresponding engineering stationing numbers as shown on the Plans.
 - 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.
- F. This transparent information will appear on the extreme upper left hand third of the screen. The 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. This transparent information must appear in the lower half of the viewing screen.
- G. 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.
- H. 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. High-resolution photographs may be submitted digitally, in color, and must include a time and date stamp on the photograph, and be accompanied by a suitable description of location of photograph either on the photo or in a caption.
- I. 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.
- J. DVD disks or USBs be properly identified as to Project, location, time, and date in a manner acceptable to OWNER.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 4500 Quality Control

Part 1 General

1.01 General Requirements

- A. Sampling of materials will be made by ENGINEER in accordance with the methods designated by the Specifications. CONTRACTOR shall furnish such facilities as ENGINEER may require for collecting, storing, and forwarding samples to the Laboratory. CONTRACTOR in all cases shall furnish the required samples to OWNER without charge.

1.02 Control of Installation

- A. Monitor quality control over Suppliers, manufacturers, products, materials, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from ENGINEER before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. Secure products and materials in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 Tests of Materials

- A. Materials in the Work shall meet the requirements of the Contract Documents.
- B. Tests of materials will be made as specified herein. CONTRACTOR will appoint, employ, and pay for specified services of an independent firm to perform inspecting and testing, as required for concrete testing, soils compaction density and gradation testing, and asphalt density testing.
 - 1. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by ENGINEER or OWNER.
 - 2. Inspecting, testing, and source quality control may occur on or off the project site. Perform off site inspecting or testing as required by ENGINEER or OWNER.
- C. Reports will be submitted by the independent firm to ENGINEER, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- D. ENGINEER shall have access to materials intended for use in the Work as well as to the plants where such materials are produced. Plant inspection may be made if the quantities are sufficient to warrant such inspection and if it is to the best interest of OWNER. In any case materials may be either inspected or tested when received on the Project.

- E. Materials shall not be used until approval has been received from ENGINEER. Approval of materials at the producing plant does not constitute a waiver of ENGINEER's right for re-examination at the Project site.
- F. Standards for testing materials, unless otherwise specified, shall be as established by the American Society for Testing and Materials (ASTM). Tests of materials will be made in accordance with the methods described or designated in the Specifications.
- G. Sampling and testing of materials not specifically mentioned shall be done by generally accepted methods, unless otherwise specified by ENGINEER.
- H. Notify ENGINEER and independent firm 48 hours prior to expected time for operations requiring services.
- I. Testing or inspecting does not relieve CONTRACTOR of performing Work to Contract requirements.
- J. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by ENGINEER. Payment for retesting will be charged to CONTRACTOR by deducting inspecting or testing charges from the Contract Price.

1.04 Certification of Materials

- 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 Contract Documents.

1.05 Source Quality Control

- A. Testing identified in the Specifications as Source Quality Control, which is required to establish quality of materials, equipment or fabricated items, shall be paid for by CONTRACTOR.

1.06 Inspector Days

- A. Resident Project Representative(s) will be assigned to the Project by ENGINEER, as necessary (in the opinion of ENGINEER) to adequately monitor CONTRACTOR's work.
 - 1. When multiple CONTRACTOR crews are working on the Project, multiple Resident Project Representatives may be assigned to the Project.
- B. If the quantity of Work under the Contract is changed, the number of "Inspector Days" shall be increased or decreased as determined by Article 10 or 11 of the General Conditions. This revision in the number of Inspector Days shall be agreed upon at the time the Contract quantities are revised.
- C. CONTRACTOR shall give ENGINEER at least 48 hours notice, exclusive of Saturdays, Sundays or holidays, when the Project requires an increase or decrease in the number of Resident Project Representatives.
 - 1. Failure to observe this requirement will either necessitate the charging of 4 hours show-up time if the Resident Project Representative appears on the Project, or the halting of all additional operations until a Resident Project Representative is available.

- D. Unless the Resident Project Representative is notified in advance, Inspector days will be charged when a Resident Project Representative appears on a project and CONTRACTOR decides not to work.
- E. A separate Inspector Day or a partial Inspector Day shall be charged for each and every Resident Project Representative working on a project for monitoring purposes.

1.07 Mockups

- A. Tests will be performed under provisions identified in this Section and identified in the respective specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mockups are representative of the quality required for the Work.
- D. Where mockups have been accepted by ENGINEER and is specified in specification section(s) to be removed, CONTRACTOR shall remove mock up and clear area when directed to do so.

1.08 Manufacturers' Field Services and Reports

- A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 30 days of observation to Engineer for information.

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 Emergency Access

- A. CONTRACTOR shall provide and maintain 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.

1.03 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 than original, and adequate for normal travel.

1.04 Road Closing

- A. No street, road or section thereof, whether public or private, 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.

1.05 Maintaining Traffic

- A. CONTRACTOR shall provide access for traffic 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.

1.06 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.

1.07 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.

1.08 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.

1.09 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.

1.10 Potable Water

- A. CONTRACTOR shall furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including OWNER and ENGINEER.

1.11 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.

1.12 Engineer's Field Office

- A. When called for in the Summary of Work, Section 01 1100, CONTRACTOR shall furnish and maintain, for the exclusive use of ENGINEER, an approved weatherproof building as a field office. The building shall be located as directed by ENGINEER, in full view of the Work and with at least one (1) window facing construction operations. ENGINEER's field office shall meet the following minimum requirements:
 - 1. Securely fixed to foundation
 - 2. Structurally sound and watertight
 - 3. Stairs and landings for doors as necessary
 - 4. Three hundred (300) square feet (28 m²), minimum
 - 5. Three operable and locking windows with screens
 - 6. Two locking, standard sized, entrance/exit doors
 - 7. 120-volt electrical service per NEC, complete
 - 8. One 30" x 60" (.75m x 1.5m) desk
 - 9. One four drawer locking file cabinet
 - 10. Two desk chairs
 - 11. One first aid kit
 - 12. One 10A:80-B:C fire extinguisher
 - 13. Automatically controlled heating, ventilating, air conditioning system to maintain temperature between 68° and 76° Fahrenheit (20° and 25° Celsius) year-round.
- B. CONTRACTOR shall furnish and maintain bottled water and sanitary facilities for the field office. CONTRACTOR shall clean the office at least once per week. CONTRACTOR shall provide and pay for utility service throughout the duration of the Project, including telephone service and long-distance telephone service.
- C. A trailer having equal facilities and floor space may be used in place of the above described field office if so desired.
- D. The field office shall be furnished with a minimum of an aggregate surfaced driveway and parking area, for the exclusive use of ENGINEER, for at least three (3) vehicles.
 - 1. CONTRACTOR shall maintain parking area including snow removal.
- E. Cost for furnishing and installing the field office, for furnishing utilities and utility service, and for maintenance of the field office and facilities, unless otherwise specified in the Proposal, will not be paid for separately but shall be included in the price bid for various items of Work under the Contract.
 - 1. The building shall be removed by the CONTRACTOR upon completion of the Contract and shall become his property.

1.13 Bypass Pumping

- A. CONTRACTOR shall maintain flow in existing sewers at all times by pumping, bypassing, or fluming as necessary.
 - 1. During wet weather events, the flow in the sewer will rise rapidly and may become surcharged.
 - 2. CONTRACTOR shall maintain flow in such a manner as the existing flow can be adequately transported including wet weather flow.

3. CONTRACTOR shall furnish, install, operate, and maintain temporary pumping facilities to service the upstream area including piping, temporary channels, pumps, sumps, controls, temporary plugs, and bulkheads.
- B. For sanitary sewerage, by-pass piping shall be PVC Schedule 80, ABS truss pipe, or equivalent with solvent welded joints, or HDPE with butt fused joints.
1. Flexible hoses of whatever types are not acceptable.
 2. By-passed flow shall be discharged to a sanitary sewer of acceptable size to handle the bypassed and existing flows.
 3. CONTRACTOR shall plan his operation such that there will be no backups, leaks, or discharges of pollutants.
- C. CONTRACTOR shall also furnish and have available onsite, redundant pumping facilities in case of any failure of the pumping system including pumps, piping, electrical, connections, etc.
1. Redundant pumping facilities also include having a backup power generator in case the primary power source fails.
 2. CONTRACTOR shall provide an adequate labor force to oversee the by-pass pumping including providing labor to maintain 24 hour per day operation and emergency backup service.
- D. Costs for pumping and bypassing flow shall be included in the unit price bid for other items of Work unless otherwise specified in the Proposal.
- E. CONTRACTOR shall submit a by-pass pumping/diversion scheme to ENGINEER for approval not less than 15 days prior to any anticipated bypass pumping/diversion. Bypass plan shall include pumping capacity and expected flow rates.

Part 2 Products (Not Used)

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 2319: Dewatering
- F. Section 31 2333: Trenching and Backfilling
- G. Section 31 3500: Slope Protection
- H. Section 32 9219: Seeding
- I. Section 32 9223: Sodding
- J. Section 33 1100: Water Utility Distribution Piping
- K. Section 33 3000: Sanitary Utility Sewerage Piping
- L. Section 33 3400: Sanitary Utility Force Mains
- M. Section 33 4100: Storm Utility Drainage 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 Turbidity Barrier

- A. Geotextile fabric curtain suspended from flotation devices at the water surface and held in a vertical position by a ballast chain in the lower hem. Turbidity barrier curtain shall meet the following minimum requirements unless otherwise specified on the plans.
1. Consist of vinyl laminate on 1000 denier polyester fabric weighing 18 ounce per square yard (610 g/m²) minimum.
 2. Tensile strength of fabric shall be 220 lbs (100 kg) minimum.
 3. Edges of fabric to be reinforced with minimum 5/8-inch (16 mm) diameter polypropylene rope.
 4. Ballast chain minimum 5/16-inch (8 mm) galvanized steel.
 5. Buoyancy blocks providing buoyancy of 18lbs/l.f (27 kg/m).
 6. Length of curtain (water depth) 5-feet (1.5 m).

2.03 Dewatering Discharge Filter Bag

- A. UV-stabilized, non-woven geotextile bag to filter sediment from water prior to discharging. Geotextile fabric shall meet the following minimum average roll requirements:
1. Tensile Strength: 180 lb-f (200 N) minimum; ASTM D4632
 2. Elongation: 50 percent minimum; ASTM D4632
 3. CBR Puncture Strength: 300 lb-f minimum; ASTM D6241
 4. Trapezoidal Tear: 70 lb-f (310 N) minimum; ASTM D4533
 5. Flow Rate: 80 gal/min/sf. (54 l/s/m²) Minimum; ASTM D4491
 6. Permittivity: 1.4 sec⁻¹ minimum; ASTM D4491
 7. Apparent Opening Size: 80 U.S. Std. Sieve maximum; ASTM D4751
 8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.04 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 sf. (0.8 kg/ m²) approximate weight.
 3. 100% agricultural straw 0.5 lbs/sy (.27 kg/m²).
 4. Stitch spacing: 1.5 inches (40 mm) on centers.

- B. Pegs shall be 6-inch (150 mm) long, hardwood pegs.

2.05 Bonded Fiber Matrix

- A. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high-strength, non-toxic 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.

2.06 Inlet Filter Fabric

- A. Filter fabric shall be constructed of 100% continuous polyester needle-punched non-woven engineering fabric. Filter fabric shall be fabricated to provide a direct fit with the drainage structure cover. Filter fabric shall have the following minimum physical properties.
 - 1. Tensile Strength: 80 lb-f (.355 kN) minimum; ASTM D4632
 - 2. Elongation: 50 percent minimum; ASTM D4632
 - 3. CBR Puncture Strength: 300 lb-f, minimum; ASTM D6241
 - 4. Trapezoidal Tear: 70 lb-f (310 N) minimum; ASTM D4533
 - 5. Flow Rate: 80 gal/min/sf. (54 l/s/m²) Minimum; ASTM D4491
 - 6. Permittivity: 1.4 sec⁻¹ minimum; ASTM D4491
 - 7. Apparent Opening Size: 100 U.S. Std. Sieve (150 µm) maximum; ASTM D4751
 - 8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.07 Acceptable Manufacturers

- A. Acceptable manufacturers include the following:
 - 1. Turbidity Barrier: Tough Guy Type II by Aer-flo Canvas Products, Inc.
 - 2. Wood Fiber Mulch: EcoFibre by Canfor Corporation.
 - 3. Polyacrylamide Binder: HydroTurboNet by Straw Net, Inc.

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/m²) 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 Section 32 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 Dewatering Discharge

- A. Should it be necessary for CONTRACTOR to do any dewatering during the course of construction, CONTRACTOR shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water.
- B. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

3.09 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.

3.10 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.
2. Weekly Storm Water Meeting:
 - a. A weekly storm water meeting will be held by CONTRACTOR with those involved in ground-disturbing activities to review the requirements of the permits, the SWPPP, and address any problems that have arisen in implementing the SWPPP or maintaining the BMPs.
 - b. CONTRACTOR shall maintain a log of weekly meetings and document the issues addressed in the meetings on site.
3. Agency Storm Water Inspections:
 - a. A log of inspections by federal, state, or local storm water or other environmental agencies shall be kept in CONTRACTOR's SWPPP.

- b. The log form should include the date and time of visit and whether a report was issued or will be issued as a result of the inspection.
- c. Any reports issued will be sent to ENGINEER within 24 hours.

3.11 Project Completion

- A. Remove temporary soil erosion and sedimentation control devices as soon as permanent measures have been established.

End of Section

Section 01 6000 Product Requirements

Part 1 General

1.01 Transportation and Handling

- A. CONTRACTOR shall provide for expeditious transportation and delivery of materials and equipment to the Project site in an undamaged condition and on a schedule to avoid delay of the Work. Materials and equipment shall be delivered in original containers or packaging with identifying labels intact and legible.
- B. CONTRACTOR shall provide equipment and personnel at the site to unload and handle materials and equipment in a manner to avoid damage. Materials and equipment shall be handled only at designated lifting points by methods to prevent bending or overstressing.

1.02 Storage and Protection

- A. CONTRACTOR shall store materials and equipment immediately on delivery and protect it until installed in the Work.
- B. Products subject to damage by elements shall be stored in weather-tight enclosures with temperature and humidity ranges as required by manufacturer's instructions.
- C. Loose granular materials shall be stored on solid surfaces to prevent mixing with foreign matter.
- D. The place of storage shall be located so as to minimize interference with traffic and to provide easy access for inspection. No material shall be stored closer than five (5) feet (1.5 m) to the edge of a pavement or traveled way open to the public.
- E. Materials that have been stored shall be subject to retest and shall meet the requirements of their respective specifications at the time they are to be used in the Work.
- F. CONTRACTOR shall provide protection of stored or installed materials and equipment as necessary to prevent damage from traffic and subsequent operations.

1.03 Manufacturer's Instructions

- A. When the Contract Documents require that installation of Work shall comply with manufacturer's instructions, CONTRACTOR shall obtain and distribute copies of such instructions to parties involved in the installation including two (2) copies to ENGINEER.
- B. CONTRACTOR shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements. Should Project conditions or specified requirements conflict with manufacturer's instructions, consult with ENGINEER for further instructions.

1.04 Products List

- A. Within four (4) days of request, CONTRACTOR shall submit a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor, if applicable, to ENGINEER.

1.05 Contractor's Product Options

- A. For products specified only by reference standard, CONTRACTOR shall select any product meeting that standard.
- B. For products specified by naming several products or manufacturer's CONTRACTOR shall select any one of the products or manufacturers named, which complies with the specifications.
- C. For products specified by naming one or more products or manufacturers and "or equal," CONTRACTOR must submit a Substitution Request Form for any product or manufacturer not specifically named, in accordance with the General Conditions.
- D. For products specified by naming only one product and manufacturer, there is no option.

1.06 Equipment Startup and Testing

- A. CONTRACTOR shall perform a comprehensive startup and demonstration of equipment performance and compliance with the design requirements. When there is more than one mode of operation, the equipment shall be operated in every mode to verify proper operation.
- B. When equipment is to operate in conjunction with other equipment as a system, each piece of equipment shall be operated both by itself and automatically as a system to verify its proper operation.
- C. CONTRACTOR is to provide to ENGINEER, in advance of startup, a schedule and listing of startup and testing procedures for review by ENGINEER. Checklists and diagrams may be required to ensure adequate startup and testing. ENGINEER may recommend changes to the startup procedure as necessary.
- D. Equipment is to be inspected prior to operation for debris or other obstructions. Equipment is to be properly lubricated and calibrated prior to operation. CONTRACTOR shall make all adjustments necessary to assure correct operation. When required, equipment installation and operation is to be witnessed and checked by manufacturer.
- E. When required, CONTRACTOR shall train OWNER's operation and maintenance personnel in the proper operation and maintenance of each piece of equipment and the system as a whole.
- F. Equipment startup is to be witnessed by OWNER and ENGINEER.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 7123.26

Construction Survey and Staking

Part 1 General

1.01 Scope of Work

- A. CONTRACTOR shall furnish labor, materials, tools and equipment necessary to perform construction layout, control, and reference staking for satisfactory completion of the project. This includes, but is not limited to:
 - 1. Placing, replacing (if necessary), and maintaining construction layout points;
 - 2. Preparing construction layout drawings, sketches, and computations; and
 - 3. Recording data in field books such as alignment, slope stake, blue top, drainage layout, bridge, and other books used for layout for this Project.

1.02 Submittals

- A. Submit the following documentation in accordance with Section 01 3300:
 - 1. Project Construction Records:
 - a. These records detail information that OWNER/ENGINEER uses to determine the template line for the as-built cross sections, which defines the computation line for unclassified excavation. These records include:
 - (1) Survey records
 - (2) Bound field notebooks
 - (3) Computer printouts that record the Project's construction
 - 2. Survey Documents:
 - a. Furnish the ENGINEER with a copy of survey documents that relate to construction layout. Provide these documents when ENGINEER requests, or as they are completed. ENGINEER may check the documents for accuracy and may require revisions where necessary. The documents become property of OWNER and will be included in the permanent Project records.

1.03 Qualifications

- A. Personnel:
 - 1. Staking shall be performed under the direct supervision of a Land Surveyor licensed by the State in which the Project is located.
 - 2. CONTRACTOR shall furnish personnel, working under the supervision of a Registered Professional Engineer or Registered Land Surveyor, who are fully qualified and capable of establishing or reestablishing line and grade points necessary to complete the work within the generally accepted surveying tolerances, and ensure that they are acceptable for the work being performed.

B. Equipment:

1. Equipment shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment. Records of repairs, calibration tests, accuracy checks and adjustments shall be maintained and be available for inspection by ENGINEER. Equipment shall be checked, tested, and adjusted as necessary in conformance with manufacturer's recommendations.

Part 2 Products

2.01 Hubs

- A. Hubs shall be 1½ inch x 1½ inch x 16-inch oak and witness stakes shall be 1-inch x 1-inch x 36-inch oak or other hardwood.
- B. Hubs with tacks shall be used for control points, centerline or baseline offsets and structure stakeout and shall be accompanied by witness stakes marked with the pertinent information. For supplemental stakeout only, witness stakes alone may be used. For laser grade control and the verification of the laser elevation a hub with witness shall be provided.

Part 3 Execution

3.01 Preparation

- A. General Pre-Construction:
 1. Before beginning construction ensure that plan dimensions, alignment, and elevations are compatible with existing field conditions. Make adjustments where necessary.
 2. Ensure alignment tie-ins by coordinating construction layout with that of other Prime Contractors whose work abuts any portion of the work. Adjustments are subject to ENGINEER's approval.

3.02 General

- A. Establish the Centerline:
 1. Establish or reestablish the centerline from the monuments and/or reference points OWNER will provide.
 2. On widening or reconstruction Projects, establish the horizontal and vertical alignment of the existing roadway and bridges.
 3. Modify the Plan horizontal and vertical alignment to conform to the existing alignment as necessary.
- B. Verify the Accuracy of the Benchmark(s):
 1. OWNER will furnish at least one benchmark that CONTRACTOR shall preserve, and if necessary, relocate as follows:

- a. Verify the accuracy of the benchmark(s) and report discrepancies to ENGINEER.
 - b. Establish additional benchmarks needed for construction.
 - c. Maintain the benchmarks for necessary OWNER/ENGINEER checks.
- C. Flag In-Place Survey Control Monuments:
 - 1. Flag and protect in-place survey control monuments and reference points, including Right-of-Way/property line intersections, as follows:
 - a. Pay for and replace destroyed or disturbed stakes or monuments.
 - b. When included as Pay Items, stake Right-of-Way markers.
- D. Line, Grades, and Stakes:
 - 1. Set other line and grade stakes needed to construct the job, including stakes needed to relocate utilities and restake flattened slopes, minor grade or alignment changes, and other incidentals.
- E. Stake Centerline Control Alignments:
 - 1. Stake centerline control alignments shown on the Plans or adjusted as described above when ENGINEER needs accurate measurement of quantities for payment. Stake these control alignments as follows:
 - a. Stake the alignments to an accuracy of 1:5000.
 - b. Stake alignments just before OWNER takes aerial photography or field cross sections for both original and final cross sections.
 - c. Provide OWNER with elevations of positions staked for OWNER's quantity measurements. Ensure that these elevations are of third order accuracy, or better. Determine them using the differential leveling method.
 - d. Take intermediate cross sections required because of stage construction, detours, or other reasons.
- F. Provide Graphic Sketches:
 - 1. Prepare and use graphic sketches of superelevation runout on curves on multi-lane roadways and of tie-ins of ramps to mainline on freeways and expressways to help provide positive drainage, adequate superelevation, and a pleasing appearance. Prepare and use similar sketches for street or roadway intersections.
- G. Maintain the Stakes:
 - 1. After construction has begun in any segment of the Project, maintain the stakes that identify construction station numbers and locations as follows:

- a. Ensure that stakes are placed at intervals not to exceed 200 ft (60 m) and use even, 100 ft (30 m) stations. Mark and flag stakes so that they are visible to OWNER/ENGINEER in that segment of the Project until construction is complete.
- b. During grading activities in fills or cuts over 20 ft (6 m), extend slope stakes up or down the slopes in intervals of 10 ft (3 m) or less to achieve an accurate cross section.

3.03 Quality Acceptance

- A. ENGINEER's acceptance of CONTRACTOR's layout shall not relieve CONTRACTOR of responsibility to secure proper dimensions for the completed work. CONTRACTOR shall, at his own expense, correct work incorrectly located due to layout error.

End of Section

Section 01 7700 Closeout Procedures

Part 1 General

1.01 Cleaning

- A. CONTRACTOR shall perform periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and wind-blown debris, resulting from construction operations.
- B. Waste material, debris and rubbish shall be periodically removed from the site and disposed of at legal disposal areas away from the site.
- C. Prior to OWNER acceptance CONTRACTOR shall conduct an inspection of sight-exposed interior and exterior surfaces, and all Work areas, to verify that the entire Work is clean.
- D. CONTRACTOR shall broom clean exterior paved surfaces and rake clean other exterior surfaces of the site.
- E. Clean and repaint with matching color scratched, marred or otherwise damaged painted surfaces of equipment and enclosures.

1.02 Project Record Documents

- A. On completion of the Work, prior to CONTRACTOR's application for final payment, and as a condition to its approval by ENGINEER and OWNER, CONTRACTOR shall arrange such site records in order in accordance with the various sections of the specifications bind them together and index them and deliver them to ENGINEER.
- B. CONTRACTOR shall request a complete set of reproducible Contract Drawings, and transfer all as-built revisions and changes to them and deliver them to the ENGINEER. These drawings shall be dated and marked "RECORD DOCUMENTS".
- C. Reproducible tracings made by CONTRACTOR, Subcontractors, equipment manufacturers, and/or Suppliers shall be corrected to show the Work as actually completed or installed and a reproducible copy of these drawings shall then be turned over to ENGINEER.
- D. Written approval or other evidence satisfactory to ENGINEER of the final conditions of the work shall be obtained from:
 - 1. Public authorities or agencies having jurisdiction over any portion of the work
 - 2. Others as requested by ENGINEER in writing.
- E. Public authorities or agencies having jurisdiction over any part of the work shall be determined, and all the requirements of these authorities or agencies with respect to but not limited to inspection, permits, fees, approval, and the like regardless of whether they are listed above or not shall be met.
- F. CONTRACTOR shall deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings, Samples, Certificates, approvals, etc. annotated to show all changes made during the construction process, to ENGINEER upon completion of the Work and prior to CONTRACTOR's application for final payment. Submittal of the record documents shall be made with a transmittal letter containing:

1. Date
2. Project Title and Number
3. CONTRACTOR's Name and Address
4. Title and Number of each Record Document
5. Certification that each Document as submitted is complete and accurate
6. Documents shall be submitted in good order and in a legible condition.

1.03 Operation and Maintenance Data

- A. Prior to final inspection or acceptance, CONTRACTOR shall fully instruct OWNER's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems specified.
- B. Operation and maintenance data required by the individual Specification sections and the manufacturer's operation and maintenance data required in Section 01 3300, Submittal Procedures, shall constitute the basis of such instruction.

1.04 Spare Parts and Special Tools

- A. Spare Parts:
 1. As soon as practicable after approval of the list of equipment, CONTRACTOR shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and source of supply.
 2. CONTRACTOR shall also furnish a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished a part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one (1) year at the particular installation.
 3. The foregoing shall not relieve CONTRACTOR of any responsibilities under the guarantee provisions of these Specifications.
 4. CONTRACTOR shall deliver all spare parts required by this contract to ENGINEER or as directed by ENGINEER.
- B. Special Tools:
 1. CONTRACTOR shall furnish at no additional cost to OWNER with each piece of equipment, one complete set of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
 2. CONTRACTOR shall submit for approval by ENGINEER a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.
 3. CONTRACTOR shall deliver all special tools required by this contract to ENGINEER or as directed by ENGINEER.

1.05 Start Up

- A. Equipment start-up period for the training of plant personnel shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for that part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
- B. During the equipment start-up period, CONTRACTOR shall furnish at no additional cost to OWNER the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - 1. Assist in the start-up and operations of the equipment.
 - 2. Assist in the training of facility personnel, designated by OWNER, in the proper operation and maintenance of the equipment.
- C. OWNER shall:
 - 1. Provide the necessary personnel to be instructed in the operation and maintenance of the equipment. OWNER's personnel shall operate all equipment.
 - 2. Pay for all fuel, power and chemicals consumed beyond quantities specified or in the Contract Documents or required due to CONTRACTOR's fault. CONTRACTOR shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
- D. CONTRACTOR shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total facility operation.
- E. In the event a system, equipment, or component proves defective or is unable to meet specified performance criteria, CONTRACTOR shall replace the defective item and the one (1) year guarantee period for the item shall start after satisfactory replacement and testing of the item.

1.06 Substantial Completion

- A. When CONTRACTOR considers that the Work, or portion thereof which the OWNER agrees to accept separately, is substantially complete, the CONTRACTOR shall prepare and submit to ENGINEER a comprehensive list of items to be completed or corrected.
- B. CONTRACTOR shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of CONTRACTOR to complete all Work in accordance with the Contract Documents.
- C. Upon receipt of CONTRACTOR's list, ENGINEER will make an inspection to determine whether the Work or designated portion thereof is substantially complete.
- D. If ENGINEER's inspection discloses any item, whether or not included on CONTRACTOR's list, which is not in accordance with the requirements of the Contract Documents, CONTRACTOR shall complete or correct such item upon notification by ENGINEER. CONTRACTOR shall then submit a request for another inspection by ENGINEER to determine Substantial Completion.

- E. When the Work or designated portion thereof is substantially complete, ENGINEER will prepare a Certificate of Substantial Completion which shall establish responsibilities of OWNER and CONTRACTOR for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the CONTRACTOR shall finish all items on the list accompanying the Certificate. The Certificate of Substantial Completion shall be submitted to OWNER and CONTRACTOR for their written acceptance of responsibilities assigned to them in such Certificate.
- F. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

1.07 Warranties

- A. CONTRACTOR shall submit duplicate copies of all warranties prior to final Application for Payment. CONTRACTOR shall also execute, assemble and submit transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- B. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as start of warranty period.
- C. All parts of the work or equipment which is in the opinion of ENGINEER prove defective in material, workmanship, or operation within the warranty period shall be removed and replaced or repaired in a manner satisfactory to ENGINEER and at no cost to OWNER.
- D. Service material or equipment required because of the defect shall be supplied without charge.
- E. Work specified to be designed by CONTRACTOR shall be guaranteed to perform as specified.
- F. Warranty period shall be one year from the date of Substantial Completion unless:
 - 1. a greater period is specified elsewhere.
 - 2. OWNER chooses to take over and use a portion of the Work as provided for in the Specifications; in which case the warranty shall be one (1) year from said takeover and use.
- G. Equipment or work replaced and/or repaired during the warranty period shall be guaranteed for one year from the date of acceptance of the repair or replacement or until expiration of the original warranty period whichever comes later.

1.08 Final Payment and Acceptance

- A. The final inspection, final application for payment and acceptance shall be in accordance with the General Conditions.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 7900 Demonstration and Training

Part 1 General

1.01 Requirements Included

- A. Instruct and train OWNER's personnel in maintenance and operation of equipment for systems supplied and/or installed under this Contract, including the following items:
 - 1. Process, mechanical, service and other equipment as noted in the detailed specifications.
 - 2. System instrumentation.
 - 3. Primary switchgear.
 - 4. Motor control centers.
- B. Incorporate the following maintenance and operation data and training services into the training program:
 - 1. Shop Drawings.
 - 2. Equipment Operation and Maintenance Manuals.
- C. Prepare instruction training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training.

1.02 Related Requirements

- 1. Section 01 3300: Submittal Procedures
- 2. Section 01 7700: Closeout Procedures
- 3. Section 11 0500: Common Work Results for Equipment
- 4. Division 26, Electrical
- 5. Division 40, Process Interconnections

1.03 Quality Assurance

- A. Preparations of training materials and instruction to be provided shall be performed by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

1.04 Schedule of Conducting Training

- A. Classroom and field training programs shall be conducted after performance testing begins but prior to substantial completion.
- B. Training programs shall be planned and conducted for:
 - 1. Operations Personnel.
 - 2. Maintenance Personnel.

- C. Scheduling shall be coordinated through ENGINEER.

1.05 Training for Maintenance of Instrumentation

- A. Train OWNER's maintenance personnel as follows:
 - 1. Describe the overall function of each instrument and control loop installed under this Contract.
 - 2. Locating the probable source of malfunction in the instrumentation equipment and control loops, determining the symptoms of the trouble, establishing the probable cause and effecting a solution.
 - 3. Taking appropriate, preventive, and corrective maintenance procedures necessary to keep the instrumentation system in proper operating condition, including calibration and testing.
- B. Course materials to be used for training OWNER's maintenance personnel shall include pertinent portions of the submittals specified in the Specifications such as loop diagrams, calibration data, trouble-shooting guides and maintenance instructions.
- C. The training program shall not include the time required for system start-up instructions or the field acceptance test.

1.06 Training for Electrical and Mechanical Maintenance

- A. Train OWNER's maintenance personnel as follows:
 - 1. Describe the functions of the equipment installed under this Contract.
 - 2. Component preventive and corrective maintenance activities required to keep unit equipment in good operating conditions.
 - 3. The Contractor shall instruct the personnel in locating the probable source of equipment malfunctions, determining the symptoms of the trouble, establishing the probable cause, and effecting a solution.
- B. Course materials to be used for training OWNER's electrical and mechanical maintenance personnel to include pertinent portions of the operation and maintenance manuals as well as alignment tolerances, lubrication schedules, vibration analysis instruction and parameters, trouble-shooting guides and special calibration test and procedures.
- C. Method of training electrical and/or mechanical maintenance personnel shall include CONTRACTOR using OWNER's equipment to demonstrate troubleshooting, preventive and corrective maintenance procedures.
- D. The field training program shall not include the time required for system start-up instructions or the acceptance test.

1.07 Operational Training

- A. Train OWNER's operations personnel as follows:

1. Describe the functions of the equipment installed under this Contract, including how the components of a system are controlled together and what the effects of the control methods are on the system and on other upstream and downstream processes installed under this Contract.
 2. Implement start-up and shutdown procedures for each piece of equipment individually, as well as the start-up and shutdown of the systems comprising the equipment. This instruction shall include normal operation, alternative operations, and emergency operations.
 3. Understand the functions of the equipment installed under this Contract, describing the individual components and how each component is used in monitoring and/or controlling equipment and/or processes installed under this Contract.
 4. Discuss the operating modes possible as a result of the modifications and installations made under this Contract.
 5. Locating the probable source of system trouble determining the symptoms, establishing the probable cause, and re-stabilizing system efficiency or systems installed under this contract.
 6. Demonstrate necessary precautions for safe operation of the equipment, instrumentation, and control system installed under this Contract.
 7. Demonstrate emergency procedures for equipment and systems installed under this Contract.
- B. Course materials to be used for training OWNER's operation personnel include pertinent portions of the Operations and Maintenance Manuals, including start-up and shutdown procedures; descriptions of equipment and instrumentation functions and modes of operations, control and monitoring; trouble-shooting instructions and process control instructions.
- C. Methods of training OWNER's operations personnel shall include a field training program at OWNER's site consisting of classrooms and hands-on training using OWNER's equipment and systems.
- D. The field training program shall not include the time required for system start-up instructions or the field acceptance test.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 8813

Special Construction Performance Requirements

Part 1 General

1.01 Summary

- A. CONTRACTOR shall be totally responsible for the construction of the Project under scheduling conditions outlined herein and any other scheduling which may be necessary.
- B. Work shall be completed for the lump sum price submitted in CONTRACTOR's proposal. No additional compensation will be allowed for delays in the work necessary to prevent interruption of service whether specifically spelled out in this section or not.
- C. CONTRACTOR shall note the construction site area limitations as they impact on storage of excavated and construction materials. CONTRACTOR shall make all necessary provisions for off-site storage as required for his operations. Costs for this work including permits, shall be included in CONTRACTOR's lump sum price bid. Prior to commencement of site excavation, CONTRACTOR shall provide the names and locations of the offsite disposal and storage area to be used for excess excavated materials.
- D. CONTRACTOR shall notify OWNER prior to any work being conducted outside of normal business hours and shall provide notification to OWNER's personnel when workers are on site.

1.02 Coordination

- A. Prior to commencing any work on any excavation of the site, temporary construction fencing shall be installed to protect the area. The temporary fence shall be 6'-0" high chain link fence. Fencing shall be removed when final grading and site restoration begins.
- B. Restoration of the site shall be done strictly according to the requirements of these plans and specifications, under the coordination and direction of a specialist in this field. CONTRACTOR is responsible for watering, fertilizing or other care required by the plantings for one year from the date of their acceptance by OWNER.
- C. Equipment and the facilities shall be tested prior to being accepted by OWNER. Testing shall be conducted in the presence of OWNER's representative. Equipment and the facilities shall then be cleaned and turned over to OWNER in good working order.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

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 2319: Dewatering
- E. Section 31 2333: Trenching and Backfilling
- F. Section 32 1216: Bituminous Paving
- G. Section 32 1315: Sidewalks and Driveways
- H. 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 Section 01 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 Dewatering

- A. The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry condition during the various construction operations.
- B. Costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at CONTRACTOR's expense.
- C. Refer to Section 31 2319, Dewatering, for additional requirements.

3.03 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.

3.04 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.

3.05 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.

3.06 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.

3.07 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.

Neither the correctness nor completeness of such information is guaranteed or implied.
- B. Structures shall be protected, preserved or restored by CONTRACTOR, to the satisfaction of the structure owner, at no additional cost to the Project.

3.08 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.

3.09 Removal of Sewers and Culverts

- A. Unless otherwise specified in the Contract Documents, CONTRACTOR, at his expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.
- B. When a sewer or culvert is removed at a structure, CONTRACTOR shall install a masonry bulkhead in the structure.
- C. Removal of a culvert or sewer also includes the removal and disposal of end treatments or headwalls.

3.10 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.

3.11 Abandoning Structures

- A. Structure shall be broken down to at least 30 inches (750 mm) below the subgrade.
- B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by ENGINEER.
- C. Structure shall be backfilled with flowable fill to 1-foot (300 mm) above the pipes and the remainder of the structure backfilled with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1-foot (300 mm) below finished grade.
- D. The remainder of the excavation shall be backfilled with a granular material, compacted to 98% of its unit weight, and shall meet with the approval of ENGINEER.
- E. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 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.

3.13 Trees

- A. Trees excepting those specified on the Plans to be removed, shall be effectively protected by CONTRACTOR during his construction operations.
 - 1. If in the opinion of ENGINEER, the methods of protection employed by CONTRACTOR are not adequate, CONTRACTOR shall carry on his operation by tunneling, or by other approved means, which will not cause undue damage to the trees.
- B. The requirements for tree tunneling are as follows:

1. Depth of Cover:
 - a. Tunnels shall be placed at a minimum depth of 30 inches (0.75 m), measured from the ground surface to the top of the tunnel.
 2. Length of Tunnel:
 - a. Tunnel length in feet (meters) shall be in direct proportion to diameter of tree in inches (millimeters) for trees eight (8) inches (200 mm) or larger in diameter. One (1) foot of tunnel shall be constructed for each inch of tree diameter whenever the trench or any portion thereof approaches the tree trunk a distance in feet equal to one-half the tree diameter in inches.
 - b. Example: A tree 12 inches in diameter shall require a 12-foot tunnel whenever the trench or any portion thereof approaches within six (6) feet of said tree.
 3. Measurements:
 - a. Trees under 8 inches in diameter will require the same length of tunnel as 8-inch trees. Measurements of tree diameters shall be taken four (4) feet above the ground surface.
- C. Where the Plans indicate areas allowing the cutting of minor trees, care should be used to keep damage to adjacent trees to an absolute minimum. Where these areas are specifically indicated on the Plan, they are to be cleared and all trunks and branches shall be disposed of by CONTRACTOR. Debris shall not be bulldozed on to adjacent private property.
- D. Trees damaged by the construction operation shall be repaired so not to inhibit growth or replaced at the expense of CONTRACTOR. Repair or replacement shall be contingent upon agreement between the damaged tree owner and CONTRACTOR. In any event, limbs, branches and roots damaged by CONTRACTOR shall be properly pruned to the satisfaction of ENGINEER.
- E. Costs incurred for protection of trees, including tunneling, repair and replacement, if necessary, shall be at CONTRACTOR's expense.

3.14 Removing Pavement

- A. Removal of concrete and bituminous pavement as called for on the Plans shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.
- B. Pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.
- C. Cutting shall be accomplished by using a power-driven concrete saw approved by ENGINEER. Depth of the saw cut shall be a minimum of 6-inches, to ensure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.
- D. Residual concrete pavement shall not be less than five feet measured transversely, nor less than 6 feet longitudinally measured from a joint.

- E. In removing a concrete base course, where part of the existing bituminous surface is to remain in place, the bituminous surface shall be cut the full depth by the use of a power-driven saw, approved by ENGINEER along a line parallel to and at least one foot from either side of the base course removal.
- F. Old pavement with a concrete cap shall be considered as only one (1) pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.
 - 1. Removal of Curb for Curb Drop:
 - a. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling, approved by ENGINEER, so as to leave a neat surface with a maximum 1-inch lip, without damage to the underlying pavement.
 - 2. Removal of Curb and Gutter:
 - a. Where curb and gutter are to be removed, the operation shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans, or as approved by ENGINEER. However, in no case shall the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.
- G. If during the pavement removal operation any concrete or bituminous pavement or surfacing is damaged beyond the removal limits designated, the damaged pavement or surfacing shall be removed and replaced at CONTRACTOR's expense.
- H. Earth which may be removed during the pavement removal operation shall be replaced by backfilling to the proposed subgrade with a suitable material, approved by ENGINEER, at CONTRACTOR's expense.

3.15 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.

3.16 Restoration in Right-of-Way and Yard Areas

- A. Right-of-way and yard areas not paved or aggregate surfaced shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. Disturbed areas may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter shall be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 shall be restored with sod.
- B. Excess material from the restoration operation shall be disposed of by CONTRACTOR at his expense.

- C. Disturbed areas 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 restore the disturbed areas to the cross sections called for on the Plans or as determined by ENGINEER.

3.17 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.

3.18 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.

3.19 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.

3.20 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 the 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 Demolition

Part 1 General

1.01 Section includes

- A. Building/concrete structure demolition.
- B. Selective demolition of building elements for alterations purposes.
- C. Selective demolition of mechanical equipment.
- D. Selective demolition of electrical equipment.
- E. Abandonment and removal of existing utilities and utility structures.
- F. Salvage of existing items to be reused or delivered to Owner.

1.02 Reference Standards

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- C. NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities, current edition.

1.03 Definitions

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to OWNER ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 Submittals

- A. Submit in accordance with Section 01 3300.
- B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of OWNER's operations. Sequence shall be compatible with overall work sequence of construction.
- C. Health and Safety Plan (HASP). Submit a HASP for workers exposed to sewage sludge materials or other hazards as part of this work.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 Quality Assurance

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

- B. The Michigan Building Code shall control the demolition, modification or alteration of the existing buildings or structures.

1.06 Project Conditions

- A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- B. This project is in a municipal wastewater treatment plant. The work will involve contact with sewage sludge which contains pathogens and other bacteria which can affect human health. Proper care and protection for all workers coming in contact with these materials is the responsibility of CONTRACTOR. A Health and Safety Plan shall be prepared by CONTRACTOR for this purpose.
- C. Erect and maintain barriers, lights and other protective devices to prevent access to areas under construction or within the influence of the ongoing work. Provide free and safe passage to and from adjacent structures which are being used by OWNER for ongoing operations of the treatment plant.
- D. OWNER and ENGINEER assume no responsibility for the actual condition of the structures/equipment to be demolished or modified. Conditions existing at the time of inspection for bidding purposes will be maintained by OWNER insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.
- E. Promptly repair damage caused to adjacent facilities by demolition operation when directed by the ENGINEER at no cost to OWNER. Repairs shall be made to a condition at least equal to that which existed prior to construction.

1.07 Contractor's Supervision

- A. CONTRACTOR's responsibility shall include a completely equipped first aid kit, provided and maintained at the site in a clean orderly condition and shall be readily accessible at all times to CONTRACTOR's employees.
- B. CONTRACTOR shall designate certain employees who are properly instructed to be in charge of first aid. At least one such employee shall be available whenever work is in progress at the demolition site.
- C. Telephone call lists for summoning aids from outside sources, such as doctors, ambulances, and rescue squads, shall be conspicuously posted at the site.

1.08 Warranty

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General Procedures and Project Conditions

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.

2. Comply with applicable requirements of NFPA 241.
 3. Use of explosives is not permitted.
 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- B. Do not begin removal until receipt of notification to proceed from OWNER.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Protect items from damage during transport and storage.
 3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
 4. No jackhammering or other destructive methods of construction shall be used in areas where adjacent facilities which are to remain and which may be damaged by such operations exist unless approved prior by ENGINEER.
- E. Partial Removal of Paving, Concrete structures and Curbs: Neatly saw cut at right angle to surface.

3.02 Existing Utilities

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.

- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to OWNER.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to OWNER.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.03 Selective Demolition for Alterations

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Engineer before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
 - 4. When general items are noted for demolition, it is assumed that appurtenances and incidental items associated with the general item should also be demolished and removed.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction where required.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage. Prevent freezing temperatures from occurring. Maintain a minimum temperature of 40 degrees Fahrenheit in all areas where are being used for plant operations or higher temperature if necessary to operate remaining equipment.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings. Where piping or electrical lines are removed back to a functioning point, cut/cap/properly terminate the remaining functioning component.
 - 2. When pipes, conduits other equipment are removed, all fasteners for that equipment shall also be removed and all holes/damage to the existing structures from which the equipment was attached shall be filled and repaired with like materials.

- E. Mechanical/Electrical (Including but not limited to Process equipment, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. When a piece of equipment is shown to be removed, it shall be assumed that the power feed to that piece of equipment including conduit/wire/starter shall also be removed.
 5. Piping interconnecting pieces of equipment and/or associated with the system to be removed shall be removed even if not specifically shown to be removed on the drawings. Pipe supports associated with removed piping shall be removed.
 6. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
 7. Remove concrete equipment bases for equipment to be removed to the building foundation/floor.
 8. Where vents or other pipes/conduits that are to be removed pass through an existing roof/floor/wall that is to remain, the resulting hole in the roof/floor/wall shall be patched and made watertight to match the existing materials.
 9. Existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.
 10. Conduits and wires shall be abandoned or removed where shown. Wires in abandoned conduits shall be removed and disposed of off-site as required. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. Conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site.
- F. Protect existing work to remain:
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.
- G. Building/Structure demolition:
1. Demolish concrete and masonry in small sections.

2. Wherever possible, sawcut materials to be removed. Where jackhammering or other destructive means are required, care shall be taken to protect existing remaining equipment/structures.
3. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.
4. Remove structures to the lines and grades shown unless otherwise directed by ENGINEER. Where no limits are shown, the limits shall be 4-inch outside the item to be installed. The removal of masonry beyond these limits shall be at CONTRACTOR's expense and these excess removals shall be reconstructed to the satisfaction of ENGINEER with no additional compensation to CONTRACTOR.
5. After removal of parts of all of walls, slabs and like work which tie into new work or existing work, the point of junction wall be neatly repaired so as to leave only finished edges and surface exposed.

3.04 Debris and Waste Removal

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain OWNER's property, remove demolished materials from Project site and legally dispose of them in an approved landfill.
- B. Do not allow demolished materials to accumulate on-site.
- C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- D. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- E. Leave site in clean condition, ready for subsequent work.
- F. Clean up spillage and wind-blown debris from public and private lands.

3.05 Disposal of Tank Contents

- A. CONTRACTOR shall remove and dispose of the contents of tanks, wells, etc. as required to perform the Work.
- B. Liquid in tanks may be returned to the treatment plant process stream with written approval of OWNER.
- C. Provide written certification to OWNER that disposal of tank contents is in accordance with applicable state and federal regulations.

3.06 Cleaning

- A. CONTRACTOR shall clean existing surfaces as required to perform the Work including tanks, wells, channels, floors, walls, etc.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

3.07 Salvage Schedule

- A. Existing Items to Be Removed and Salvaged:

1. No existing items will be salvaged to OWNER. CONTRACTOR retains ownership and responsibility for all items shown to be removed.

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

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 $\pm$ 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 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. 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: $\pm 1/2$ inch (± 10 mm)
 - 4. All other bends: ± 1 -inch (± 25 mm).
- B. Placement:
 - 1. Concrete cover to form surfaces: $\pm 1/4$ 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: $\pm 1/4$ inch (5 mm).
 - b. Members more than eight (8) inches (200 mm) but not over two (2) feet (600 mm) deep: $\pm 1/2$ 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
- F. Section 05 1200: Structural Steel Framing
- G. Section 05 5000: Metal Fabrications
- H. Section 07 1000: Dampproofing and Waterproofing
- I. Section 31 2319: Dewatering

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/m³).
 - 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/m³).
 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 m³) 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 "Harcot," 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 m²).
 - 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 m³) 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 m³), 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 0513

Mortar and Masonry Grout

Part 1 General

1.01 Section Includes

- A. Mortar and grout for masonry.
- B. Repointing of existing masonry where called for on the Drawings or specified.

1.02 Related Sections

- A. Section 01 4500: Quality Control
- B. Section 04 2000: Unit Masonry
- C. Section 04 4316.13: Cut Limestone
- D. Section 05 5000: Metal Fabrications
- E. Section 08 1613.13: FRP Flush Panel Doors and Aluminum Frames

1.03 References

- A. TMS 402 - Building Code Requirements for Masonry Structures.
- B. TMS 602 - Specifications for Masonry Structures.
- C. ASTM C91 - Masonry Cement.
- D. ASTM C144 - Aggregate for Masonry Mortar.
- E. ASTM C150 - Portland Cement.
- F. ASTM C207 - Hydrated Lime for Masonry Purposes.
- G. ASTM C270 - Mortar for Unit Masonry.
- H. ASTM C387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.
- I. ASTM C404 - Aggregates for Masonry Grout.
- J. ASTM C476 - Grout for Masonry.
- K. ASTM C780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- L. ASTM C1019 - Method of Sampling and Testing Grout.
- M. ASTM C1072 - Method for Measurement of Masonry Flexural Bond Strength.
- N. ASTM E447 - Test Methods for Compressive Strength of Masonry Prisms.
- O. ASTM E518 - Test Method for Flexural Bond Strength of Masonry.
- P. IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.04 Submittals

- A. Submit under provisions of Section 01 3300, Submittal Procedures.
- B. Include design mix, indicating the proportion specifications of the mix per ASTM C270.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270, component mortar materials to requirements of ASTM C270 and test and evaluation reports to ASTM C780.
- E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 Quality Assurance

- A. Perform Work in accordance with TMS 402 and TMS 602.
- B. Maintain one copy of each document on site.

1.06 Delivery, Storage and Handling

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 6000, Product Requirements.
- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.07 Environmental Requirements

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees Fahrenheit (32 degrees Celsius) prior to, during, and 48 hours after completion of masonry work.
- C. Environmental requirements shall meet the Michigan Building Code requirements, Section 2104 Construction, for both construction and protection.

Part 2 Products**2.01 Materials**

- A. Portland Cement: ASTM C150, Type I, gray-white.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Water: Clean and potable.
- D. For pigmented mortar, use a colored cement formulation as required to produce the color indicated or as selected from manufacturer's standard formulations.

1. Pigments shall not exceed 10% of Portland cement by weight for mineral oxides nor 2% for carbon black.
2. Pigments shall not exceed 5% of mortar cement or masonry cement by weight for mineral oxides nor 1% for carbon black.

E. Bagged Masonry Cements.

2.02 Admixtures

- A. No admixtures shall be used without the expressed written approval of ENGINEER.
- B. It is not the intent of ENGINEER to allow the use of admixtures.

2.03 Mortar Mixes

- A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Proportion specification.
- B. Mortar for Non-Load Bearing Walls and Partitions: ASTM C270, Type S using the Proportion specification.
- C. Integral Water Repellent: Provide water repellent additive by the same manufacturer for mortar and CMU systems containing integral water repellent admixture
 1. Refer to Section 04 2200, Unit Masonry, for additional requirements and coordination.

2.04 Mortar Mixing

- A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 90 degrees Fahrenheit (32 degrees Celsius), or two-and-one-half hours at temperatures under 50 degrees Fahrenheit (10 degrees Celsius).

2.05 Grout Mixes

- A. Bond Beams, Lintels and other areas that may be called for on the Drawings: 2,000 psi (14 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; mixed in accordance with ASTM C476, fine grout.

2.06 Grout Mixing

- A. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Do not use anti-freeze compounds to lower the freezing point of grout.

2.07 Mix Tests

- A. Test mortar and grout in accordance with Section 01 4500, Quality Control.
- B. Testing of Mortar Mix: In accordance with ASTM C780 for compressive strength, consistency, mortar aggregate ratio, water content, air content, splitting tensile and strength.
- C. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength and slump.

2.08 Repointing Specifications

- A. Deteriorated mortar joints in existing Building masonry, and other areas that may be shown on the Drawings, shall be cleaned out and refilled with fresh mortar.
- B. New mortar installed as part of this work shall match the color of the adjacent mortar for the area being worked on.
- C. Joints shall be considered deteriorated if they are eroded back 1/4-inch or more from the face of the masonry units; mortar has fallen out of the joint; hairline cracks run through the mortar; or the bond between mortar and masonry unit is broken.
 - 1. As a minimum, CONTRACTOR shall include repointing of 3,000 lineal feet of mortar joints for the project.
 - 2. This repointing is in addition to specific areas specified or shown on the Drawings to be repaired. ENGINEER shall mark in the field the areas that will be repointing.
 - 3. The repointing and repairs shall be done after new masonry weeps are installed.
- D. Raking the Old Mortar Joints:
 - 1. Mortar joints should be raked out to at least 1/2-inch depth or, if the joint is more than 1/2-inch thick, to a depth as great as the thickness of the mortar joint.
 - 2. If the mortar is still unsound at 1/2-inch, the joint shall be cut deeper.
 - 3. Unsound mortar shall be removed without disturbing the brick.
- E. Mortar may be removed with a hand-held grinder, a small mason's chisel, or a special raking tool.
 - 1. If the grinder is used to rake vertical joints, care shall be taken not to cut the brick in the next course above or below the joint.
 - 2. Before repointing, brush all loose fragments and dust from the joint or flush them out with a stream of water.
- F. Repointing mortar should closely match the existing mortar in strength, hardness, color, and texture.
- G. Test the existing mortar to see what mix proportions were used.

1. Type N mortar may be used if the original mortar cannot be duplicated.
 - a. Type N mortar should be made from 1-part Portland cement, 1-part Type S hydrated lime, and 4-1/2 to 6 parts sand.
2. The mortar ingredients shall be high quality.
 - a. Portland cement (gray or white) shall meet the requirements of ASTM C 150, Type I or IA.
 - b. Hydrated mason's lime should meet the requirements of ASTM C 207, Type S. Hydraulic quicklime.
 - c. Sand should meet ASTM C 5 and C 144 requirements, respectively.
 - d. Do not use admixtures.
3. To compensate for shrinkage, a prehydration process shall be used.
 - a. Mix the dry ingredients with only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball.
 - b. Keep the mortar in this damp condition for 1 to 2 hours and then add the remaining water required.
 - c. Mortar for repointing should be somewhat drier than mortar used to lay masonry units.
 - d. This drier mix is easier to place:
 - e. It does not flow to the bottom of the joint after it has been pushed into the joint with the repointer's trowel.
4. To see if the color of the new mortar matches the color of the old mortar, test a sample area in an inconspicuous spot before repointing the entire job.
 - a. Use a garden hose to soak a portion of the wall.
 - b. The color of the new mix should match the darker color of the wetted old mortar.
 - c. Minor adjustments, such as adding or subtracting sand or cement, may be necessary (but they must stay within the limits set by ASTM C 270 for the type of mortar selected).
 - d. A record shall be kept of the exact proportions so the same color can be reproduced in other batches throughout the job.
5. Ordinary gray or white mortars can be retempered as needed within the first 2-1/2 hours after they are mixed.
6. Colored mortars shall not be retempered.

Part 3 Execution

3.01 Examination

- A. Request inspection of spaces to be grouted.

3.02 Installation

- A. Install mortar in accordance with ASTM C270.
- B. Mortar:
 - 1. "Measurement of materials for mortar shall be by volumetric measure and be controlled and accurately maintained. Measurement by "Shovel full" shall not be permitted."
 - 2. Mortar shall be retempered as required to maintain consistency. Dispose offsite of mortar which has begun to stiffen, set or which is over 2-1/2 hours old.
 - 3. Follow color manufacturer's recommendations for re-temper colored mortar to avoid color mis-match."
- C. Work grout into masonry cores and cavities to eliminate voids.
- D. Do not install grout in lifts greater than 16 inches (400 mm) (two CMU courses without consolidating grout by rodding.
- E. Do not displace reinforcement while placing grout.
- F. Remove excess mortar from grout spaces.

3.03 Field Quality Control

- A. Field inspection and testing will be performed in accordance with the Structural Tests and Special Inspections in TMS 602, refer to Table 4.
- B. Test and evaluate mortar in accordance with ASTM C780.
- C. Test and evaluate grout in accordance with ASTM C1019.

End of Section

Section 04 2200

Unit Masonry

Part 1 General

1.01 Section Includes

- A. Face brick
- B. Concrete masonry units (CMU).
- C. Reinforcement, anchorage, and accessories.

1.02 Related Sections

- A. Section 04 0513: Mortar and Masonry Grout
- B. Section 04 4316.13: Cut Limestone
- C. Section 05 5000: Metal Fabrications
- D. Section 07 6000: Flashing and Sheet Metal

1.03 References

- A. TMS 402 - Building Code Requirements for Masonry Structures.
- B. TMS 602 - Specifications For Masonry Structures.
- C. ASTM A82 - Cold-Drawn Steel Wire for Concrete Reinforcement.
- D. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- E. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- F. ASTM A525 - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.
- G. ASTM A580 - Stainless and Heat-Resisting Steel Wire.
- H. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- I. ASTM A641 - Zinc-Coated (Galvanized) Carbon Steel Wire.
- J. ASTM C62 - Building Brick (Solid Masonry Units Made From Clay or Shale).
- K. ASTM C90 - Load-Bearing Concrete Masonry Units.
- L. ASTM C129 - Non-Load Bearing Concrete Masonry Units.
- M. ASTM C216 - Facing Brick (Solid Masonry Units Made From Clay or Shale).
- N. ASTM C652 - Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- O. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
- P. UL - Fire Resistance Directory.

1.04 Submittals

- A. Submit under provisions of Section 01 3300, Submittal Procedures.
- B. Product Data: Provide data for masonry units and fabricated wire reinforcement.
- C. Product Data: Provide data for masonry accessories, cleaning solution, dovetail anchors, flashing, joint filler, masonry mat, weep hole material, etc.
- D. Samples: Submit four samples of masonry units (if requested) to illustrate color, texture and extremes of color range.
- E. Manufacturer's Certificate: Certify that all masonry units covered by this specification meet or exceed all appropriate, referenced ASTM Specification requirements.

1.05 Quality Assurance

- A. Perform Work in accordance with TMS 402 and TMS 602.
- B. Maintain one copy of each document on site.
- C. Environmental requirements shall meet the Michigan Building Code requirements, Section 2104 Construction, for both construction and protection.

1.06 Qualifications

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.07 Pre-Installation Conference

- A. Convene one week prior to commencing work of this sections.

1.08 Delivery, Storage, And Handling

- A. Deliver, store, protect and handle products to site under provisions of Section 01 6000, Product Requirements.

1.09 Environmental Requirements

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees Fahrenheit (32 degrees Celsius) prior to, during, and 48 hours after completion of masonry work.

1.10 Coordination

- A. Coordinate the masonry work with Rough Stone veneer, installation of door frames and window anchors.

Part 2 Products

2.01 Face Brick

- A. Face brick shall be ASTM C216, Type FBX, Grade SW. Color, texture, module and size to match existing. Submit samples for OWNER review and approval.

2.02 Concrete Masonry Units

- A. All masonry block units on the project shall be uniform in color. Units that are specified to receive pigment shall have the color uniform all the way through the unit.
- B. Hollow Load Bearing Block Units (CMU): medium weight, ASTM C-90.
- C. Solid Load-Bearing Block Units (CMU): medium weight, ASTM C-90.
- D. Standard Block Size and Shape: Nominal modular size of 8 x 16 x thickness shown having a smooth face. Provide special units for 90-degree corners, bond beams, lintels, and bullnosed corners.
- E. CMU Admixture System for Single Wythe CMU Exterior Walls:
 - 1. Admixture shall consist of two polymeric admixtures.
 - a. One, covered by this short-form specification, is mixed throughout the low slump concrete during manufacture of the CMU by a Qualified CMU manufacturer.
 - b. The second admixture is added to the mortar on site, during mixing, by the mason.
 - 2. Both admixtures are necessary to achieve a water-repellent single wythe CMU wall.
 - 3. This admixture combination is only required for exterior single wythe CMU walls exposed to the weather.
 - 4. Admixtures shall be as manufactured by Krete Industries, W.R. Grace Chemicals or other approved.

2.03 CMU Integrally Insulated System

- A. CMU shall be insulated as noted on Schedule, except where solid or grout filled block are called for on the Drawings.
- B. Insulation shall be Polymaster R-501 foamed in-place insulation (www.polymaster.com) or other Engineer approved foamed in-place product with the same R value.
 - 1. Product shall be a 3-part polymer foamed in-place plastic insulation with a powder resin mixed with a catalyst and foamed with nitrogen or compressed air.
 - 2. R value per inch thickness of the insulation shall be 4.6.
 - 3. Surface burning characteristics shall meet ASTM E-84 with a flamespread of 25 and smoke developed of 50.

4. Building Code surface burning classification Class 1 or Class A.

2.04 Reinforcement and Anchorage

- A. Single Wythe Joint Reinforcement: 2 wire, ladder type; steel wire, hot dip galvanized to ASTM A153 Class B2 after fabrication, 9 gage (3.7 mm) side rods with 9 gage (3.7 mm) cross ties.
 1. Approved Manufacturers:
 - a. A-A Wire Products
 - b. Dur-O-Wal, Inc.
 - c. Hohmann & Barnard, Inc.
- B. Multiple Wythe Joint Reinforcement: 3 wire, without moisture drip; steel wire, hot dip galvanized to ASTM A153 Class B2 after fabrication, 9 gage (3.7 mm) side rods with 9 gage inch (3.7 mm) cross ties. Units shall be Hohmann & Barnard 235 or ENGINEER-approved equal.
 1. Provide a ladder type 3 wire unit for multiple wythe walls where the wythes are masonry block.
 2. Provide a ladder type 3 wire unit for multiple wythe walls where the wythes are masonry block and brick.
 3. Approved Manufacturers:
 - a. A-A Wire Products
 - b. Dur-O-Wal, Inc.
 - c. Hohmann & Barnard, Inc.
- C. Prefabricated tees and corner pieces matching truss reinforcement.
- D. Anchors for securing CMU and brick to structural steel: Type 316 Stainless Steel 1 ¼" wide x 12 ga. bent edge strap anchors with separate adjustable 12 ga. Type 316 Stainless Steel channels welded to structural steel members. Hohmann & Barnard 365 Bent Gripstay Anchors with 360 Gripstay Channels or ENGINEER-approved equal.

2.05 Mortar and Grout

- A. Mortar and Grout: As specified in Section 04 0513, Mortar and Masonry Grout.

2.06 Flashings

- A. Rubberized-Asphalt Flashing: Manufacturer's standard composite flashing product consisting of a pliable and highly adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of 0.040 inch (1.0 mm).
 1. Dur-O-Wall, Inc., Dur-O-Barrier.
 2. W.R. Grace & Co., Construction Products Division, Perm-A-Barrier Wall Flashing.
 3. Hohmann & Barnard, Inc., Textroflash.
 4. Polyguard Products, Inc. Polyguard 300.
 5. Williams Products, Inc., Everlastic MF-40.

2.07 Accessories

- A. Joint Filler (Backer Rod): Refer to Specification Section 07 9200, Joint Sealants.
- B. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- C. Air Space Maintenance Material: CavClear Masonry Mat manufactured by CavClear/Archovations, Inc. Hudson, WI 54016, (888)436-2620 or approved equal.
 - 1. The masonry mat shall be specifically designed for masonry cavities to prevent mortar from making contact with the backup.
 - 2. The masonry mat shall be fluid conducting, non-absorbent, mold and mildew resistant polymer mesh consisting of 100% recycled plastic with binder.
 - 3. Masonry mat is to be installed substantially continuous behind the full height of the brick.
 - 4. In conjunction with the rigid board insulation the masonry mat shall fill all but 1/4" of the actual cavity. Provide thicknesses as shown on the Drawings.
- D. Mortar Mesh: Mortar mesh for use in horizontal joints to prevent mortar or grout from falling through; mesh shall be monofilament screen made from galvanized wire or polypropylene polymer, DUR-O-STOP as manufactured by Dur-O-Wall, Inc., or MGS – Mortar/Grout Screen by Hohmann & Barnard.
- E. Weep Hole Vents: Provide CavClear Weep Vents manufactured by CavClear/Archovations, Inc., Hudson WI 54016, (888)436-2620 or approved equal.
 - 1. Non-woven mesh with M notched bottom.
 - 2. Color to match mortar as selected by OWNER.
 - 3. Size: 3/8-inch by 2-1/2-inches high by 3-1/2-inches wide.
- F. Control Joint Filler: : 3/8-inch thick, 3-inch wide, closed cell neoprene strip gasket. Use two 3-inch strips at CMU wall, for installed width of 6-inches.
- G. Cleaning Solution:
 - 1. Cleaning solution shall be as recommended by the cleaning solution manufacturer from their line of Masonry Cleaning Products.
 - 2. Approved manufacturers are Diedrich Technologies or ProSoCo.
 - 3. Manufacturer's printed recommendations and cleaning procedures shall be strictly followed.
 - 4. Submit Manufacturer's recommendations and procedures as part of the shop drawing submittals.

Part 3 Execution

3.01 Examination

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Verify that foundations are within tolerances specified.

2. Verify that reinforcing dowels are properly placed.
 3. Verify that the structural steel frame and miscellaneous metal work is complete, plumb, secured and properly located to allow masonry work to be installed as detailed and with adequate clearances.
- B. Foundation and steel frame discrepancies:
1. Notify ENGINEER and OWNER's Representative in writing of discrepancies.
 2. Foundation and/or steel frame discrepancies: Do not proceed with masonry work until conditions have been corrected.
 3. Foundation discrepancies affecting the masonry work shall be resolved by Foundation Contractor, the Masonry Contractor and OWNER Representative without Owner's extra cost.
 4. Steel Frame discrepancies affecting the masonry work shall be resolved by the Steel Frame Contractor, the Masonry Contractor, and OWNER's Representative without any additional cost to OWNER.
- C. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.
- D. Verify that field conditions are acceptable and are ready to receive work. ENGINEER shall be notified of any conditions not suitable to receive the Unit Masonry work.
- E. Verify items provided by other sections of work are properly sized and located.
- F. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 Preparation

- A. Direct and coordinate placement of metal anchors supplied to other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building Structure Provides Permanent Bracing.

3.03 Coursing

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Lay out work carefully in advance to make joints, both horizontal and vertical, fit the openings with a minimum of cutting.
 1. Provide joints of uniform width. Form corners as true 90-degree angles unless otherwise shown.
 2. Exposed units shall be free from chips on faces and exposed edges, and from broken corners.
- C. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

D. Face Brick Units:

1. Bond: Running (Stack Bond only as noted).
2. Lay up brick on a bed joint in a beveled peak away from the cavity to minimize mortar protrusions into the cavity.
3. Do not furrow bed joints, butter ends of stretchers, and sides of headers if used, with mortar before laying. Fill vertical joints with mortar.
4. Construct head joints by pushing units tightly into mortar against adjoining unit.
5. Lay bricks with joints of uniform width, approximately 3/8-inch, with horizontal joints level and with vertical joints plumb.
6. Tool exterior joints concave.
7. Tool joints of interior brick walls concave.
8. Provide special brickwork as required to complete the work.
 - a. Return brick into reveals at openings in walls.
 - b. Lay brick so that finished brick surface only is exposed in the finished work.
 - c. Where corner edges or cut brick are exposed, cut the brick with an abrasive saw, and provide cut brick with sharp, straight, true edges.
 - d. Refer to drawings for locations, elevations, and details of patterns of brick

E. Concrete Masonry Units:

1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8-inches (200 mm).
3. Mortar Joints:
 - a. Lay up block units on a bed joint in a beveled peak away from the cavity to minimize mortar protrusions into the cavity.
 - b. Do not furrow bed joints, butter ends of stretchers, and sides of headers if used, with mortar before laying.
 - c. Fill vertical joints with mortar. Construct head joints by pushing units tightly into mortar against adjoining unit.
 - d. Lay units with joints of uniform width, approximately 3/8-inch, with horizontal joints level and with vertical joints plumb.
 - e. Tool exterior joints concave.
 - f. Tool joints of interior block walls concave.

- F. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- G. Door jambs and other exposed corners shall be manufactured bullnosed block. Unless otherwise shown on the Drawings, grinding block in the field shall not be acceptable.

3.04 Placing and Bonding

- A. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Masonry units with damaged or mutilated insulation inserts shall not be accepted.
- C. Cores to be grouted solid shall have the CMU cross webs set in a mortar bed to prevent the grout from flowing into the adjacent cells.
- D. Provide expansion joints in masonry work.
 - 1. Between top of masonry walls or partitions and underside of steel or concrete beams, metal deck, or concrete slabs; at ends of masonry walls or partitions abutting other construction, or other masonry walls or partitions except at tooth-bonded intersections; and elsewhere as shown; by packing the space with Expansion Filler.
 - 2. Provide the last course in such walls or partitions of solid units terminating to provide 3/8-inch space minimum.
- E. Install vertical masonry mat airspace maintenance material continuously throughout the full height of all exterior masonry cavities during construction of the exterior wythe.
 - 1. Manufacturer's installation instructions shall be strictly followed.
 - 2. Verify that the air space is 1/4-inch greater than the masonry mat and insulation thickness.
 - 3. Masonry mat shall be installed horizontally between the horizontal joint reinforcement.
 - 4. Stagger end joints in adjacent rows.
 - 5. Butt adjacent pieces to moderate contact.
 - 6. Fit to perimeter construction and penetrations without voids.
- F. Install vertical mortar netting in nominal cavity between units if multiple wythes are used.
- G. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- H. Remove excess mortar as work progresses.
- I. For the finished masonry walls that will not be painted:
 - 1. Avoid use of excess mortar.

2. Remove excess mortar as work progresses.
 3. Immediately clean mortar from the face of the CMU or ACMU wall units.
 4. Precautions shall be taken to avoid staining of the finished surface of the masonry units.
- J. Interlock intersections and external corners. The intersection of all walls shall be toothed together with the intersecting wall.
 - K. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
 - L. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 - M. Broken or chipped masonry units will not be allowed. Care shall be taken during handling and installation to prevent any damage to the face and edges of all block units.
 - N. Where built-in terms are to be embedded in cores of hollow masonry units, place a grout retainer in the in joint below and rod mortar or grout into core.
 - O. Fill cores in hollow concrete masonry units with grout 24-inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
 - P. Provide mortar beds on top of walls where walls support steel framing or precast concrete members. Build up mortar beds to provide elevations required to receive such members. Trowel surface of mortar beds true and level.
 - Q. Fill the spaces between metal frames and masonry with grout.
 - R. Use cores filled with mortar or provide solid units for anchorage in locations where handrails, plumbing fixtures, utility cabinets and similar items are attached.
 - S. Construct masonry walls and partitions of proper thickness to receive pipe, ducts, conduit and similar core-run items, whether or not so dimensioned. If room sizes or critical space requirements are affected by the need for larger units, obtain approval from OWNER's Representative before proceeding.
 - T. Masonry work that shows evidence of having been frozen shall be removed and replaced with new materials.
 - U. Masonry work shall never be placed on snow- or ice-covered surfaces. The surfaces shall be cleaned and dried prior to proceeding with the new masonry work.
 - V. Wet or frozen masonry units shall not be used until they are allowed dry.
 - W. Masonry walls shall be covered at night or whenever work is not underway to prevent moisture entry into the wall.
 1. Finished walls shall have the tops of exposed walls covered to prevent moisture entry into the wall.
 2. Wall covering shall be waterproof tarps, reinforced polyethylene sheets or other approved waterproof barrier, anchored in place so they will not be displaced by the weather.

3.05 Weeps

- A. Place weep vents in head joints of exterior wythes of cavity wall located immediately above ledge and flashing, spaced 24-inches on center, unless otherwise shown.
- B. Leave the side of the masonry units forming the weep vent space unbuttered and clear of mortar. Install with the notched side down.
- C. Slide vent material into place once the two masonry units forming the weep are in place.

3.06 Reinforcement and Anchorage – Single and Multiple Wythe Masonry

- A. Install horizontal joint reinforcement 16-inches (400 mm) oc.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below all sills, lintels and other openings. Extend each side of opening from control joint to control joint.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6-inches (150 mm).
- E. Install prefabricated corners and tees.
- F. Support and secure reinforcing bars from displacement. Maintain position within 1/2-inch (13 mm) of dimensioned position.
- G. Provide reinforced walls or piers in locations shown. Install vertical reinforcing in block cores, of sizes and at spacings shown.
 - 1. Loop and wire-tie to dowels at bottom.
 - 2. If splicing of reinforcing is required, lap joints and wire-tie as required by the codes.
 - 3. After mortar has set, fill cores containing reinforcing with grout.
 - 4. If only segments of a wall are reinforced, provide setting mortar on cross-webs adjacent to segment, during laying, to contain the grout in the reinforced cores.

3.07 Masonry Flashings

- A. Extend flashings horizontally at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and at bottom of walls.
- B. Turn flashing up minimum 8-inches (200 mm) and bed into mortar joint of masonry, seal to concrete, seal to steel or other back-up.
- C. For single wythe masonry unit walls provide a double wythe to allow embedment of the flashing between the two wythes.
 - 1. The double wythe only needs to be 1 course high.
 - 2. General installation shall follow requirements for multi-wythe walls as shown on the Drawings.

- D. Lap end joints minimum 6-inches (150 mm) and seal watertight.
- E. Turn flashing, fold, and seal at corners, bends, and interruptions.

3.08 Lintels and Bond Beams

- A. Install loose steel where shown on the Drawings.
- B. Provide concrete masonry lintel units matching the stretcher units in size and texture for lintels at locations with openings greater than 24-inches.
 - 1. Place reinforcing bars as shown and fill void with grout.
 - 2. Construct lintel with a minimum of 8-inches of bearing at each end.
 - 3. Where lintel is exposed in final construction, match the bond pattern used in the wall.
 - 4. Cure field fabricated lintels before handling and installing or temporarily support built-in-place lintels until cured.
- C. Provide precast lintel units in textures, color, finish and strength to match adjacent masonry units with reinforcing bars indicated.
 - 1. Construct precast lintels with a minimum of 8-inches bearing on each side.
 - 2. Provide precast lintels with the same curing process as the adjacent masonry units.
- D. Provide concrete masonry bond beam units or other methods of grout confinement for bond beams.
 - 1. Place reinforcing bars as shown and fill void with grout.
 - 2. For continuous bond beams, lap reinforcing bars 12-inches minimum and provide bars around corners.
 - 3. Tie bond beams to structural members as shown.
- E. Install reinforced unit masonry lintels over openings, where steel or precast concrete lintels are not scheduled.

3.09 Grouted Components

- A. Place horizontal mortar mesh over cores below grouted course(s).
- B. Reinforce bond beam with 4, No. 5 bars, 1 inch from top or bottom web unless noted otherwise on the Drawings.
- C. Lap splices minimum 24 bar diameters.
- D. Support and secure reinforcing bars from displacement. Maintain position within 1/2-inch (13 mm) of dimensioned position.
- E. Place and consolidate grout fill without displacing reinforcing.

- F. At bearing locations, fill masonry cores with grout for a minimum 12-inches (300 mm) either side of opening.
- G. At vertical reinforcing steel locations, grout cores solid as shown on the Drawings.
 - 1. Insulation inserts shall remain in the grouted cores.
 - 2. Insulation inserts shall be tight to the interior surface of the block prior to the grout placement.

3.10 Control and Expansion Joints

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as shown on the Drawings and in accordance with Section 07 9200 for sealant performance.
- D. Construct typical control joints and expansion joints by breaking the running bond in the wall with a continuous thru-wall vertical joint 3/8-inch-wide and provide 1/2-inch-deep sealant space.
 - 1. In concrete masonry unit work, construct the control joint by laying up the block with the half core end at the joint; as concrete masonry units are laid up, line one side of the joint with 1 ply of Bond Breaker Strip and fill the core and web space formed at the joint with mortar, packed in place, to form a keyed joint which will withstand lateral pressure.
 - 2. In brick-concrete masonry unit work, or brickwork, fill the joint with Flexible Joint Filler Strip, recessing the strip to provide the 1/2-inch-deep sealant space.
- E. Isolation Joints
 - 1. Provide isolation joints wherever masonry encloses a steel column and elsewhere as shown.
 - 2. Construct joints by separating the masonry from the steel with Isolation Gaskets. Do not compress the Isolation Gasket.

3.11 Built-In Work

- A. As work progresses, install built-in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
- B. Install built-in items plumb level and true to line.
- C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with mortar. Fill adjacent masonry cores with mortar minimum 12-inches (300 mm) from framed openings.
- D. Do not build in organic materials subject to deterioration.

3.12 CMU Insulation Installation

- A. Handle and store products in accordance with manufacturer's published recommendations.
- B. Drill the 5/8-inch foam injection holes in the least conspicuous places.
 - 1. Holes shall be centered on the mortar joints.
 - 2. For the majority of the hole locations, use the mortar joint at the intersection of a vertical and horizontal mortar joint.
 - 3. It is anticipated that there will need to be 1 set of foam insulation injection holes located approximately 7'-4" above the finished floor.
 - 4. If more than 1 set of injection holes are required vertically, consult with ENGINEER prior to drilling additional holes.
- C. Install foam in CMU cores to a uniform density.
- D. Completely fill all spaces, crevices and voids.
 - 1. Verify density of foam in-place insulation by filling a 1 gallon open top bag. When foam is cured bag shall weigh between 285 and 325 grams.
 - 2. Drill a minimum of 10 holes in locations requested by ENGINEER to verify complete filling of the masonry wall cores.
 - 3. If deficiencies are found, additional holes shall be drilled until ENGINEER is satisfied that all problems have been located.
 - 4. Correct any deficiencies found during the inspection.
 - 5. Repair all inspection holes.
- E. Repair all foam injection and inspection holes by cleaning to the full depth of the original mortar and filling with fresh mortar finished to the profile and texture of the original mortar. Mortar colors shall match.
- F. Do not install foamed in-place insulation if air temperatures are below 50 degrees or expected to fall below 50 degrees during the 12 hours after installation.

3.13 Tolerances

- A. Maximum Variation from Alignment of Columns or Pilasters: 1/4-inch.
- B. Maximum Variation from Unit to Adjacent Unit: 1/32-inch.
- C. Maximum Variation from Plane of Wall: 1/4-inch in 10 ft and 1/2-inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4-inch per story non-cumulative; 1/2-inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8-inch in 3 ft and 1/4-inch in 10 ft; 1/2-inch in 30 ft.

- F. Maximum Variation of Joint Thickness: 1/8-inch in 3 ft.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4-inch.
- H. Maximum Variation of Head Joint Alignment, Every Second Course: 1/8-inch in 2 ft and 1/4-inch in 8 ft.

3.14 Cutting and Fitting

- A. Cut and fit for chases, pipes, conduit, sleeves, grounds, etc. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 Field Quality Control

- A. Field inspection and testing will be performed under provisions of Section 01 4500.
- B. Field Inspections / Quality Assurance.
 - 1. Special masonry inspections shall be required for engineered masonry that is part of non-essential buildings as defined MBC Section 1705.4.
 - a. Refer to Structural drawings for additional requirements and criteria.
 - b. Seismic resistance testing shall be in accordance with MBC Section 1705.13.

3.16 Cleaning

- A. Clean work under provisions of Section 01 7700.
- B. Clean exposed surfaces of masonry thoroughly to remove mortar, dirt, paint spots, stains, efflorescence and defacements.
 - 1. Protect exposed adjacent materials during installation and cleaning operations.
 - 2. Remove mortar droppings from aluminum and other metal surfaces daily.
 - 3. Do not use sand blast, or other materials or methods that will stain, discolor, or damage the masonry surfaces in any way.
- C. Point up joints full and even and to match tooling used on wall.
 - 1. Cut out and point up defective joints during or before cleaning.
 - 2. Clean out and provide proper-depth recesses for calking and sealing work.
 - 3. Mortar shall match adjacent installations in color and texture.
- D. Brush clean concrete masonry units as the work progresses.
 - 1. Allow mortar droppings on such surfaces to dry and then remove by trowel, block-rubbing and brushing.

- E. Protect surfaces that could be harmed by cleaning operations.
- F. Clean face brick with warm water, detergent and fiber brushes.
 - 1. IF such cleaning is ineffective, use specified brick cleaning solution following the manufacturer's instructions.
 - 2. Cleaning solutions from Diedrich or ProSoCo may be used as necessary to remove stains from the masonry block and must be approved by ENGINEER prior to starting the work.
 - a. CONTRACTOR shall start with the mildest cleaning solution available and work to the stronger cleaning agents if the stains persist.
 - b. All solutions shall be tested in inconspicuous places to verify that they are not detrimental (change texture or color) to the appearance of the wall surface.
 - 3. Immediately flush surfaces thoroughly with clean, clear water.
 - 4. Also, immediately flush adjacent surfaces upon which solution has dropped or splashed. Do not use high-pressure power washers.
 - 5. The walls shall be cleaned as many times as necessary to remove stubborn and persistent stains.
 - 6. If stains are such that they cannot be successfully removed from the surface of the masonry unit, the masonry unit shall be cut from the wall and a new non-stained masonry unit matching the existing wall units shall be tuck-pointed into place.
- G. It is OWNER and ENGINEER's intention to have a uniform appearance in the final wall surfaces.
- H. For soiled stone surfaces, clean joints and exposed surfaces with fiber brush and soap powder and rinse thoroughly with water.
- I. Clean glazed face material units with detergent, warm water and fiber brushes.
- J. Remove all excess materials, debris, equipment, sample panels, etc. From site upon completion and acceptance of masonry work.
- K. Use non-metallic tools in cleaning operations.

3.17 Protection of Finished Work

- A. Protect finished Work under provisions of Section 01 4500.
- B. New masonry walls shall be protected at night to prevent the entrance of moisture into the exposed top of walls.
 - 1. Wall protection shall be provided until such time as the wall is permanently protected from moisture by subsequent construction.

2. Walls not being actively worked on shall be protected from moisture continuously during the work interruption.
 3. Wall coverings shall be plastic or canvas as approved by ENGINEER.
 4. Wall coverings shall be held in place securely to prevent being displaced by wind or weather conditions.
- C. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.
- D. If masonry work becomes stained after the cleaning process has been completed and prior to acceptance of the completed building by OWNER, CONTRACTOR shall clean the walls again, in accordance with the above specified procedures, to make them acceptable.

3.18 Schedules

- A. Exterior Walls: Composite masonry with an exterior wythe of brick veneer, bonded with wire reinforcement, as detailed, to inner wythe of interior facing concrete block masonry (CMU). Insulation to be board type, applied to face of CMU. Thickness of CMU to be as noted on the drawings.
- B. Interior Partitions: Single wythe concrete block units with Integral Insulation.

End of Section

Section 04 4313.13

Cut Limestone

Part 1 General

1.01 Section Includes

- A. Cut limestone caps at limestone sills at window openings.
- B. Metal anchors, mortar, and joint pointing.

1.02 Related Sections

- A. Section 04 0513: Mortar and Masonry Grout: Limestone bed and joints.
- A. Section 04 2000: Unit Masonry: Masonry supporting wall.
- B. Section 05 5000: Metal Fabrications: Shelf angles and supports.
- C. Section 07 6000: Flashing and Sheet Metal: Coping, lintel, and sill flashings.
- D. Section 07 9200: Joint Sealants: Sealant and backer rod for limestone installation.

1.03 References

- A. ASTM A123 - Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
- B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- C. ASTM C270 - Mortar for Unit Masonry.
- D. ASTM C387 - Packages, Dry, Combined Materials for Mortar and Concrete.
- E. ASTM C568 - Limestone Building Stone.
- F. ILI (Indiana Limestone Institute of America, Inc).
- G. IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.04 Submittals

- A. Submit under provisions of Section 01 3300, Submittal Procedures.
- B. Shop Drawings: Indicate layout, pertinent dimensions, anchorages, reinforcement, head, jamb, and sill opening details, control jointing methods.

1.05 Quality Assurance

- A. Perform work in accordance with ILI Standard Specifications.

1.06 Qualifications

- A. Stone Supplier: Company specializing in quarrying cut stone with minimum ten years' experience.
- B. Installer: Company specializing in performing the work of this section with minimum three years' experience.

- C. Design anchors and supports under direct supervision of a registered Professional Structural Engineer, registered in the State of Michigan.

1.07 Delivery, Storage, And Handling

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 6000, Product Requirements.
- B. Store stone panels on a pallet, off the ground.
- C. Protect stone from discoloration.

1.08 Environmental Requirements

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Specifications for Cold Weather Masonry Construction.
- B. During temporary storage on site, at the end of working day, or during rainy weather, cover stonework exposed to weather with non-staining waterproof coverings, securely anchored.

1.09 Sequencing

- A. Sequence work to coordinate the installation of stonework with installation of adjacent construction.

Part 2 Products

2.01 Limestone

- A. Limestone: Cut Indiana Oolitic Limestone.
- B. Grade: Select.
- C. Color: Grey or Buff.
- D. Surface Texture: Smooth.

2.02 Accessories

- A. Anchors, Dowels, and Ties: Stainless steel to ASTM A167, Type 316, of sizes and configurations required for support of stone and applicable superimposed loads.
- B. Supports: Stainless steel Type 316.
- C. Bolts, Washers and Nuts: Stainless steel Type 316.
- D. Setting Shims: Plastic type.
- E. Spacers: Plastic Type.
- F. Flashings: Specified in Section 07 6000, Flashing and Sheet Metal.
- G. Sealant: Specified in Section 07 9200, Joint Sealants, to match stone color.
- H. Cleaning Solution: Type which will not harm stone, joint materials, or adjacent surfaces.

2.03 Mortar Mix

- A. Setting Mortar: Type M using the Property Method.
- B. Do not use anti-freeze compounds to lower the freezing point of mortar.
- C. If water is lost by evaporation, re-temper only within two hours of mixing.
- D. Use mortar within two hours after mixing at temperatures of 80 degrees Fahrenheit (26 degrees Celsius), or two-and-one-half hours at temperatures under 50 degrees Fahrenheit (10 degrees Celsius).

2.04 Stone Fabrication

- A. Thickness and Face Size: As shown and detailed on the Drawings, cut square.
- B. Fabrication Tolerances: Shall be in accordance with ILI Standards
- C. Fabricate units for uniform coloration with adjacent units and over the full area of the installation.
- D. Slope exposed top surfaces of stone and horizontal sill surfaces for natural wash.
- E. Cut drip slot in work projecting more than 1/2-inch (13 mm) over adjacent work. Size slot not less than 3/8-inch (10 mm) wide and 1/4-inch (6 mm) deep; full width of projection.

Part 3 Execution**3.01 Examination**

- A. Verify that support work and site conditions are ready to receive work or this section.
- B. Establish lines, levels, and coursing. Protect from disturbance.

3.02 Preparation

- A. Establish lines, levels, and coursing. Protect from disturbance.
- B. Verify that items built-in under other sections are properly located and sized.
- C. Clean stone prior to erection. Do not use wire brushes or implements which will mark or damage exposed surfaces.

3.03 Installation

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joint minimum 6-inches (150 mm) and seal watertight.
- B. Erect stone in accordance with stone supplier's instructions and erection drawings.
- C. Arrange stone pattern to provide a consistent joint width of 3/8 inch.
- D. Provide setting bed, backer rod and sealant in accordance with Sections 04 0513 and Section 07 9200.

- E. Place setting buttons and set stone in full mortar setting bed to support stone over full bearing surface and to establish joint dimensions.
- F. Shore up units until setting bed will maintain stone in position without movement.
- G. Fill dowel and lifting holes with mortar.
- H. To accommodate backer rod and sealant, rake out joints 3/4- to 1-inch. Brush mortar joints clean.

3.04 Tolerances

- A. Positioning of Elements: Maximum 1/4-inch (6 mm) from true position.
- B. Maximum Variation from Plane of Wall: 1/4-inch in 10 feet (6 mm in 3 m); 1/2-inch in 50 feet (13 mm in 15 m).
- C. Maximum Variation Between Face Plane of Adjacent Stones: 1/16-inch (1.5 mm).
- D. Maximum Variation of Joint Thickness: 1/8-inch in 3 feet (3 mm/m).

3.05 Cutting and Fitting

- A. Obtain approval prior to cutting or fitting any item not so indicated on Drawings.
- B. Do not impair appearance or strength of stonework by cutting.

3.06 Cleaning

- A. Remove excess mortar upon completion of work.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

End of Section

Division 05
Metals

Section 05 1200 Structural Steel Framing

Part 1 General

1.01 Scope of Work

- A. The extent of structural steel work is indicated on the Contract Drawings, including schedules, notes, and details to show size and location of members, typical connections, and type of steel required.

1.02 Related Work Specified Elsewhere

- A. Section 03 3000: Cast-In-Place Concrete
- B. Section 04 0511: Mortaring and Grouting

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. AISC - American Institute of Steel Construction
 - 2. ASTM- American Society for Testing and Materials
 - 3. AWS - American Welding Society

1.04 Codes and Standards

- A. Comply with the provisions of the following, except as otherwise indicated.
 - 1. AISC - "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. AISC - "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," including the "Commentary and Supplements" thereto as issued.
 - 3. AISC - "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 - 4. AWS D1.1 - "Structural Welding Code."
 - 5. ASTM A6 - "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

1.05 Qualifications for Welding Work

- A. Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months. If recertification of welders is required, retesting will be CONTRACTOR's responsibility.

1.06 Design of Members and Connections

- A. Details indicated on the Contract Drawings are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the site whenever possible without causing delay in the Work.

- B. Connection details not shown on the plans shall be designed in accordance with the most current addition of the AISC "Manual of Steel Construction."
- C. Promptly notify ENGINEER whenever design of members and connections for any portion of the structure is not clearly indicated.

1.07 Allowable Tolerances

- A. Overall Length:
 - 1. Members with both ends milled for contact bearing: + 1/32 inch (0.8 mm).
 - 2. Members without ends milled for contact bearing which are framed to other members:
 - a. 30 feet (9 m) or less in length $\pm$ 1/16 inch (1.5 mm).
 - b. Over 30 feet (9 m) in length $\pm$ 1/8 inch (3 mm).
- B. Straightness:
 - 1. Structural members may vary from straightness within the tolerances allowed for wide flange shapes by ASTM Specification A6, except that the tolerance on deviation from straightness of compression members is 1/1,000 of the axial length between points which are to be laterally supported.
 - 2. Completed members should be free from twists, bends and open joints. Sharp kinks or bends are cause for rejection of material.
- C. Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1:500.

1.08 Source Quality Control

- A. Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
- B. Promptly remove and replace materials or fabricated components which do not comply.

1.09 Submittals

- A. For information only, submit two (2) copies of producer's or manufacturer's specifications and installation instructions for the following products including laboratory test reports and other data as may be required to show compliance with these specifications (including specified standards). Indicate by transmittal that copy of each applicable instruction has been distributed to Fabricators, Installers, and Erectors.
 - 1. Structural Steel, including certified copies of mill reports covering the chemical and physical properties.
 - 2. High-strength bolts including nuts and washers.
 - 3. Unfinished bolts and nuts.

4. Structural steel primer paint.
 5. Shrinkage-resistant grout.
 6. Slide bearings.
- B. Submit shop drawings, prepared by a professional engineer registered in the state where the Work is located, including complete details and schedules for fabrication and shop assembly of members, connections, and details. Also include schedules, procedures, and diagrams showing the sequence of erection.
 - C. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
 - D. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.

1.10 Delivery, Storage, and Handling

- A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed by ENGINEER.

1.11 Sequencing with Related Work

- A. Supply fabricated structural steel members and/or accessories to be installed by related Work. Bearing plates shall be furnished complete with anchor bolts, washers, nuts and setting diagrams or templates.

1.12 Environmental Requirements

- A. Allowances shall be made during erection of structural steel for ambient air temperatures specified under Article 3.07 of this Section.

Part 2 Products

2.01 Structural Steel

- A. Rolled Steel Wide Flange and Tee Shapes: ASTM A 992.
- B. Other Rolled Steel Plates, Shapes, and Bars: ASTM A572, G50, unless otherwise indicated on the plans.
- C. Hollow Structural Sections: ASTM A500, Gr B. Steel Pipe: ASTM A53, Type E or S, Grade B.
- D. Anchor Bolts: ASTM A307, non-headed type unless otherwise indicated on the Contract Drawings.

2.02 Washers, Bolts, and Nuts

- A. Washers: ASTM F436
- B. Bolts and Nuts:
 - 1. Standard: Grade A ASTM A307, with nuts conforming to Grade A ASTM A563.
 - 2. High Strength: Type 1 ASTM A325, with heavy hex nuts conforming to Grade DH ASTM A563.
 - 3. Alloy Steel: Type 1 ASTM A490, with heavy hex ASTM A194.

2.03 Miscellaneous Structural Items

- A. Electrodes for Welding: Comply with AWS Code; Use E 70 XX Series.
- B. Structural Steel Primer Paint: Inorganic Zinc-Rich Epoxy Primer Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C588, Type A.

2.04 Shop Fabrication and Assembly

- A. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the final shop drawings. Provide camber in structural members where indicated on the Contract Drawings.
- B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- C. Where finishing is required, complete the assembly, including welding of units before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

2.05 Connections

- A. Weld or bolt shop connections as indicated on the Contract Drawings.
- B. Bolt field connections except where welded connections or other connections are specified.
- C. Provide high-strength threaded fasteners for all principal bolted connections, except where unfinished bolts are indicated on the Contract Drawings.
- D. Provide unfinished threaded fasteners for only the bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erections.
- E. Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts."

- F. Comply with AWS Code for procedures, appearance, quality of welds, and methods used in correcting welding work.
- G. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.06 Holes for Other Work

- A. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members as indicated on the Contract Drawings and/or final shop drawings.
- B. Provide threaded nuts welded to framing, and other specialty items as indicated on the Contract Drawings, and/or final shop drawings to receive other work.
- C. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.07 Shop Painting

- A. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on portions which are exposed and initial two (2) inches (50 mm) of embedded areas only.
- B. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
- C. After inspection and before shipping, clean all steel work whether painted or not. Remove loose rust, loose mill scale, spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) SP-2 "Hand Tool Cleaning" and SP-3 "Power Tool Cleaning."
- D. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness at 2.0 mils (50 µm). Use painting methods which will result in full coverage of joints, corners, edges, and all exposed surfaces.

Part 3 Execution

3.01 CONTRACTOR'S Verification

- A. CONTRACTOR must examine the areas and conditions under which structural steel work is to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTOR.
- B. The inspection and verification of construction in place shall be sufficiently in advance of steel erection to allow for possible correction of the construction in place or fabrication.
- C. If the construction in place is not inspected by CONTRACTOR prior to erection, CONTRACTOR shall be responsible for removing and resetting construction in place or revisions in fabrication to correct discrepancies.

3.02 Erection - General

- A. Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.

3.03 Temporary Shoring and Bracing

- A. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.

3.04 Temporary Planking

- A. Provide temporary planking and working platforms as necessary to effectively complete the Work.

3.05 Anchor Bolts

- A. Furnish anchor bolts and other connectors required for securing structural steel to foundations.
- B. Furnish templates and devices as necessary for presetting bolts and other anchors to accurate locations. Templates shall be 1/8" (3 mm) thick (min) steel plate.

3.06 Setting Bases and Bearing Plates

- A. Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.
- B. Clean the bottom surface of base and bearing plates.
- C. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
- D. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.
- E. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain.
- F. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's installations, or as otherwise required.

3.07 Field Assembly

- A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact.
- B. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

- C. Level and plumb individual members of the structure as specified in Article 1.07 of this Section unless otherwise specified by AISC tolerances.
- D. Establish required leveling and plumbing measurements on the mean operating temperature of the structure. Make allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
- E. Splice members only where indicated on the Contract Drawings and/or final shop drawings.
- F. Erection bolts on exposed welded construction, shall be removed and holes filled with plug welds and ground smooth at exposed surfaces.
- G. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
- H. Do not enlarge undersized holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- I. Do not use cutting torches in the field for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to ENGINEER. Finish gas-cut sections equal to a sheared appearance when field cutting is permitted.

3.08 Touch-Up Painting

- A. Immediately after erection clean field welds, bolted connections, and abraded areas of the shop paint. Apply paint to exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (50 μm).

3.09 Field Quality Control

- A. General:
 - 1. OWNER may engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports. Inspections will meet requirements of the current building code at the place of the Work.
 - 2. Testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.
 - 3. Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
 - 4. Testing agency may inspect structural steel at the plant before shipment; however, ENGINEER reserves the right to reject material not complying with specified requirements.

5. CONTRACTOR shall correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Performance of additional tests necessary to reconfirm any noncompliance of the original work and to show compliance of corrected work will be at CONTRACTOR'S expense.
6. Work determined to be defective by ENGINEER and/or local agencies regardless of all previous inspections, shall be corrected to the satisfaction of ENGINEER at no extra cost to OWNER. CONTRACTOR shall be responsible for the cost and delay of replacing defective Work both in regard to his own Contract and as such cost or delay affects the Work of others.

B. Connections:

1. Inspect shop bolted connections in accordance with AISC Specifications. Inspect and test not less than five (5) percent of the shop and field welds during fabrication and erection of structural steel assemblies as follows:
 - a. Certify welders and conduct inspections and tests as required.
 - b. Record types and locations of all defects found in the work.
 - c. Record work required and performed to correct deficiencies.
 - d. Perform visual inspection of all welds complying with ASTM E164.
2. Inspection of field bolted connections will be in accordance with AISC Specifications.

End of Section

Section 05 5000 Metal Fabrications

Part 1 General

1.01 Section Includes

- A. This Section includes shop fabricated steel and aluminum items as indicated on the Plans complete with materials, fabrication and installation.

1.02 Related Work Specified Elsewhere

- A. Section 03 1500: Concrete Accessories
- B. Section 03 3000: Cast-in-Place Concrete
- C. Section 05 1200: Structural Steel Framing

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. AISC – American Institute of Steel Construction
 - 2. ASTM – American Society of Testing and Materials
 - 3. FS – Federal Specifications
 - 4. OSHA – Occupational Safety and Health Act

1.04 Design Criteria

- A. Grating, railings, stairs and hatches shall be capable of supporting loads as indicated unless otherwise shown on the Plans.
- B. Top rail and supports of Guardrail System:
 - 1. Concentrated load of 200 lbs. (90 kg) applied at any point in any direction.
 - 2. Uniform load of 50 pounds per linear foot (75 kg/m) applied to the top rail horizontally with a simultaneous load of 100 lbs. per linear foot (150 kg/m) applied vertically downward.
- C. Handrail not serving as top rails:
 - 1. Horizontal concentrated load of 200 lbs. (90 kg) applied at any point.
 - 2. Uniform load of 50 pounds per linear foot (75 kg/m) applied at any point.
 - 3. Concentrated and uniform loads need not be assumed to act concurrently.
- D. Intermediate rails (all those except handrails), balusters and panel fillers:
 - 1. Horizontal applied normal load of 50 pounds (220 N) on an area not to exceed 1 square foot (925 cm²) including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of preceding paragraphs.
- E. Gratings, hatches and stairs:

1. Uniformly distributed load of 200 lbs per square foot (975 kg/m²) of horizontal surface.
 2. Maximum allowable deflection is 1/4 inch (5 mm) with 150 pounds per square foot (730 kg/m²) uniformly distributed load or 500 pounds (225 kg) concentrated load applied at mid-span.
- F. Stairway and ladder design shall conform to the latest Michigan OSHA requirements for loading, rail sizes, and dimensions.

1.05 Requirements of Regulatory Agencies

- A. The latest Federal OSHA Standards, as adopted by the State of Michigan, and as they relate to floor and wall openings, grating, stairways, ladders and skylights, shall apply to the Work of this specification where applicable.
- B. Expansion anchor bolts shall meet OSHA requirements for pull out and shear.

1.06 Quality Assurance

- A. Manufacturer's Qualifications:
1. Design connections and components not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Michigan.
- B. Inspection:
1. Work done in accordance with this specification shall be subject to inspection. OWNER/ENGINEER shall have access to all places of manufacture where materials are being produced or fabricated, or where tests are being conducted and shall be accorded full facilities for inspection and observation.

1.07 Submittals

- A. Submit shop drawings showing layout, fabrication dimensions, anchoring details and erection information for stair nosings, ladders, grating and floor hatches. Include pull-out and shear-strength information for recommended anchor bolts.
- B. Fabrication and/or erection of items done prior to ENGINEER review of shop drawing shall be at the risk and expense of CONTRACTOR.
- C. When requested by ENGINEER, submit mill or laboratory certified copies of testing reporting chemical analysis and physical property of metal used in fabrication of items of this Section.
- D. Submit affidavits when requested by ENGINEER, certifying that the grating, handrail, and ladder capacities comply with the requirements as specified and indicated in this Section or on the Plans.
- E. Certification that the equipment meets OSHA 1910.27 standard for Climber Protection shall be submitted.

1.08 Product Delivery, Storage, and Handling

- A. Deliver miscellaneous metal items in an undamaged condition. Damaged items shall be repaired or replaced to the satisfaction of OWNER at the expense of CONTRACTOR.
- B. Store items to permit easy access for inspection and identification. Keep items off the ground, using pallets, platforms, or other supports. Protect unpackaged and packaged items from erosion and deterioration of shop paint or finish surface.
- C. Do not store on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replacement shall be to the satisfaction of OWNER at the expense of CONTRACTOR.

1.09 Protection

- A. Installed anchor bolts, inserts and other miscellaneous metal items shall be protected while other Work is being performed. Installed items that are damaged shall be repaired or replaced at CONTRACTOR's expense.

1.10 Sequencing

- A. Anchors, frames, or other miscellaneous metal items to be embedded in concrete shall be provided on site as required for uninterrupted construction sequence.

1.11 Guarantee

- A. Floor hatches shall bear the manufacturer's 5-year guarantee for proper operation and against defects in materials and workmanship.

Part 2 Products

2.01 Zinc Coating

- A. Unless otherwise indicated on the Plans or specified herein, miscellaneous metals shall receive zinc coatings as follows:
 - 1. Steel Shapes, Plates or Bars: ASTM A123
 - 2. Hardware of Steel or Iron: ASTM A153
 - 3. Assembled Steel Products: ASTM A123

2.02 Plates, Sheets, Shapes and Bars

- A. Steel: ASTM A36
- B. Aluminum:
 - 1. Plate and Sheet: Alloy 6061, Temper T6, ASTM B209
 - 2. Extruded Shapes and Bars: Alloy 6061 T6, ASTM B221
- C. Stainless steel: ASTM A316

2.03 Tubing

- A. Steel:

1. Hot Formed Welded or Seamless Rolled: ASTM A501A1011, Grade 50
2. Cold Finished: Formed, ASTM A512A500, Grade C
3. Aluminum: Alloy 6061 T6, ASTM B221

2.04 Pipe

- A. Steel: Black finish unless otherwise specified, Type E or S, Grade B, Schedule 40, ASTM A53
- B. Aluminum: Alloy 6061 T6, ASTM B429

2.05 Expansion Anchor Bolts

- A. Expansion anchor bolts shall be furnished and installed in accordance with Section 03 1500, Concrete Accessories.

2.06 Grating and Stair Treads

- A. Steel:
 1. Minimum 3/16 inch (4 mm) thick bearing bars manufactured from USS "Cor Ten" Steel with Blaw Knox Ponbake, Bordon Bo Ly, or approved equal finish. Stair treads shall have minimum 1 inch (25 mm) wide diamond plate nosings.
- B. Aluminum:
 1. Standard rectangular bar manufactured from Alloy 6061 T6, ASTM B221 with standard finish. Stair treads shall have abrasive nosings.

2.07 Concrete Stair Nosing

- A. Ferrous metal tread nosing with abrasive tread surface. Nosing shall be minimum 1/8-inch thick, shall have a minimum of 4-inch legs on the horizontal surface of the tread and 2-inch leg on the vertical surface of the riser, and shall extend the full width of the tread. Nosing shall be integral with the concrete stairs by steel studs or anchors. Nosing shall be painted with an approved epoxy paint system.

2.08 Railings

- A. Pipe railing system shall consist of top and intermediate rail with posts and kickplates. Handrail system for stairs shall consist of top and intermediate rail, and posts.
- B. Aluminum rail and posts shall be nominal 1-1/2" (40 mm) diameter, Schedule 40. All fittings shall be extruded aluminum, machined to final shape. All fasteners shall be stainless steel. Fabricate railing systems and handrails for connection of members by means of manufacturer's standard concealed mechanical fasteners and fittings unless otherwise approved.
- C. Steel rails and posts shall be minimum 1-1/2" (40 mm) diameter, schedule 40, black steel pipe of flush welded construction.

2.09 Ladders

- A. All items for ladders and associated safety devices shall be manufactured from aluminum alloy as stated above with stainless steel anchor bolt unless otherwise noted on the plans.

2.10 Fabrication

A. General:

1. Miscellaneous steel fabrications shall conform to AISC Code of Standard Practice. Welding where permitted and performed shall be in accordance with AWS Code for Welding in Building Construction.
2. Fabricate items to dimensions on plans or ENGINEER approved shop drawings. Use the type of materials of size and thickness as indicated on the Plans or specified herein. All structural members framing into beams or columns, unless otherwise detailed on the Plans, shall have standard framing connection angles of sufficient strength to develop the full strength of the member, even though the design stress may be less. Connections shall be bolted, welded or other ENGINEER approved means. Exposed connections shall be flush. Grind welds smooth to match and blend with adjoining surfaces.
3. Ferrous metal fabrications not to be galvanized or embedded in concrete shall be coated with a primer as specified in Division 9 of the Technical Specifications or as specified for individual items.

B. Grating and Stair Treads:

1. Grating shall be fabricated with span lengths and panel widths as indicated on the Plans. Bearing and cross bars shall be spaced evenly and provide the required loading capacity. Edges of grating panels shall be solid, flush for the full depth of the grating.

C. Ladders:

1. Ladders shall be fabricated in accordance with the details shown.
2. Ladder climbing safety devices such as cages shall be provided for all ladders 20 feet (6 m) or greater in length.

D. Floor Hatches:

1. Hatches shall be of sizes indicated on the Plans. Frame and door shall be aluminum with stainless steel hinges and pins unless otherwise called for on the plans. Provide spring counter balanced operators, automatic hold open arm with release handle and snap lock with removable handle. Hardware shall be stainless steel unless otherwise noted on the plans. Door shall have diamond checkered pattern.
2. Frames shall be neatly mitered and shall have welded corners and anchors.
3. Aluminum surfaces to come in contact with concrete, wood, and dissimilar metals shall be shop coated with alkali resistant bitumastic paint as specified in Division 9 of the Technical Specifications.

E. Lintels:

1. Steel lintels shall be provided for openings as shown and scheduled. Lintels shall have not less than four (4) inches (100 mm) of bearing on each end and shall have an additional 1 inch (25 mm) of bearing at each end for each 1 foot

(300 mm) of clear span over four (4) feet (1200 mm), unless otherwise shown. Horizontal sections of lintels between the edge of the masonry opening and the end of the lintel shall be coped to allow for masonry joint not less than 1 inch (25 mm) deep measured from the interior and exterior faces of the masonry wall. See Lintel Schedule shown at the end of this Section.

2. Where steel plates are used in connection with structural shapes, they shall be welded to such structural shapes.

F. Guard Chains:

1. Where indicated on the Plans, chains shall be 3/16 inch (4 mm) cadmium plated steel link construction, provided with snap type fasteners at each end to permit attachment to posts and/or wall eyelets. Two (2) strands of chain, mounted at heights equal to guardrails, shall be installed wherever noted on the Plans.

G. Guard Posts:

1. Guard posts shall be 6-inch (150 mm) diameter, steel pipe conforming to ASTM A53, Schedule 80, filled with concrete. Guard Posts shall be galvanized steel unless otherwise shown on the plans. Guard posts to be painted shall have:
 - a. 2 – 3 mil polyamide epoxy primer
 - b. 2 – 3 mil aliphatic acrylic polyurethane, semi-gloss total dry film thickness 4 – 6 mils

2.11 Acceptable Manufacturers

- A. Acceptable manufacturers of steel grating include: Blaw Knox "Cor Ten" steel with "Ponbake" finish; Gary Bo Ly; or equal.
- B. Acceptable manufacturers of aluminum grating include: Reliance Steel Products Company; Gary Aluminum Grating, manufactured by IKG Industries; or equal.
- C. Acceptable manufacturers of floor hatches include: Babcock Davis Associates, Inc.; Bilco Company; Halliday Products Inc., or equal.

Part 3 Execution

3.01 Installation – General

- A. Miscellaneous metal items shall be installed plumb, level, square and true, set at proper elevations and positioning. Bearing surfaces and surfaces to be in permanent contact shall be cleaned of dirt, rust, and other substances before the members are assembled.
- B. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.02 Installation of Anchor Bolts

- A. Drill holes of diameter and depth recommended by anchor manufacturer. Clean hole of dust and debris before inserting anchor. Assemble anchor and complete installation according to manufacturer recommendations.

3.03 Installation of Grating, Floor Hatches, and Stair Nosings

- A. Install items at locations indicated on the Plans in accordance with manufacturer's recommendations. Frames to be embedded in concrete shall be installed flush with the finished floor and shall be carefully leveled so that the plates of gratings do not rock.
- B. Install stair nosings on concrete stairs.
- C. Install eyelets in walls and/or posts for securing guard chains as indicated on the Plans. Mount chain strands at elevations equal to railings.

3.04 Installation of Guard Posts

- A. Guard posts shall be set a minimum of 3' 6" (1 m) below finished grade in a concrete foundation as shown on the Plans. Guard posts shall extend 5' 0" (1.5 m) above finished grade.

3.05 Installation of Railings

- A. Provide pipe railing system with maximum 8-foot (2400 mm) maximum post spacing and minimum 42-inch (1050 mm) railing height to top rail. Top rail of handrailing system shall be 34-inches (865 mm) high as measured from the leading edge of any tread. Provide minimum 3-inch (75 mm) clearance from the wall for single pipe handrail supported on brackets.
- B. Provide removable pipe railings with close-fitting sleeves set in concrete where indicated on the Plans. Sleeves shall be 1-inch (25 mm) less in length than thickness of concrete.

3.06 Steel Lintel Schedule

See Next Page for Steel Lintel Schedule

Wall Thickness	Opening Length	Description (inches and pounds)	Remarks
8"	Up to 3'-6"	2 - 3-1/2"x3-1/2"x5/16"	See Notes Nos. 2 & 3
	3'-6" to 6'-6"	2 - 4"x3-1/2"x5/16"	SLH, See Notes Nos. 2 & 3
	6'-6" to 12'-6"	W8x10 1 - 5/16"x6-1/2" Plate	
12"	Up to 3'-6"	3 - 3-1/2"x3-1/2"x5/16"	See Note No. 3
	3'-6" to 6'-6"	3 - 4"x3-1/2"x5/16"	SLH, See Note No. 3
	6'-6" to 12'-6"	W8 x 18 1 - 5/16"x10-1/2" Plate	
14"	Up to 3'-6"	2 - 3-1/2"x3-1/2"x5/16" 1 - 5"x3-1/2"x5/16"	LLH, See Note No. 3
	3'-6" to 6'-6"	2 - 5"x3-1/2"x5/16" 1 - 5"x5"x5/16"	SLH, See Note No. 3
	6'-6" to 12'-6"	W8x18 1 - 5/16"x12-1/2" Plate	
16"	Up to 3'-6"	3 - 5"x3-1/2"x5/16"	LLH, See Notes Nos. 2 & 3
	3'-6" to 6'-6"	3 - 5"x5"x5/16"	See Notes Nos. 2 & 3
	6'-6" to 12'-6"	W8 x 18 1 - 5/16"x14-1/2" Plate	Provide 1/4" Plate Stiffener, Each Side at 24" O.C.
18"	Up to 3'-6"	W8x10 1 - 5/16"x16-1/2" Plate	
	3'-6" to 6'-6"	W8x13 1 - 5/16"x16-1/2" Plate	Provide 1/4" Plate Stiffener, Each Side at 24" O.C.
	6'-6" to 12'-6"	W8x18 1 - 5/16"x16-1/2" Plate	Provide 1/4" Plate Stiffener, Each Side at 24" O.C.

- NOTES:
1. For openings larger than 12'-6", see Plans for size and shape.
 2. See Specifications for coping requirements.
 3. Provide 5/16" x (Wall Thickness - 1-1/2") Plate, when seam is exposed to view.
 4. SLH = Short Leg Horizontal.
 5. LLH = Long Leg Horizontal.

End of Section

Section 05 5100

Metal Stairs

Part 1 General

1.01 Scope of Work

- A. Section includes stairs with grating treads, structural steel stair framing and supports, handrails, and guards.

1.02 Related Sections

- A. Section 03 3000: Cast-in-Place Concrete
- B. Section 05 5000: Metal Fabrications
- C. Section 05 5200: Guardrails and Handrails
- D. Section 09 9100: Painting

1.03 Quality Assurance

- A. Reference Standards:
 - 1. ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel; 2005.
 - 2. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2005.
 - 3. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
 - 4. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
 - 5. ASTM A 283/A 283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2003.
 - 6. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2004.
 - 7. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2004b.
 - 8. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
 - 9. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2005a.
 - 10. ASTM E 935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2000.
 - 11. ASTM E 985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000.

12. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 1998.
13. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006.
14. NAAMM AMP 510 - Metal Stairs Manual; The National Association of Architectural Metal Manufacturers; 1992, Fifth Edition.
15. NAAMM MBG 531 - Metal Bar Grating Manual; The National Association of Architectural Metal Manufacturers; 2000.
16. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
17. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
18. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

B. Structural Designer Qualifications:

1. Professional Structural Engineer experienced in design of this work and licensed in the State of Michigan, or personnel under direct supervision of such an engineer.

C. Welder Qualifications:

1. Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.04 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - a. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - b. Include the design engineer's stamp or seal on each sheet of shop drawings.

B. Certificates:

1. Welders' Certificates.

Part 2 Products

2.01 Metal Stairs – General

- A. Metal Stairs:** Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, State, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
 2. Structural Design: Provide complete stair and railing assemblies complying with the following:
 - a. Stair Capacity: Uniform live load of 100 lb/sq ft and a concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/180 of span.
 - b. Railing Assemblies: Comply with ASTM E 985.
 3. Dimensions: As indicated on drawings.
 4. Shop Assembled Components: disassemble into largest practical sections suitable for transport and access to site.
 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
1. Industrial: All joints made neatly.
 - a. Welded Joints: Welded on back side wherever possible.
 - b. Welds Exposed to Touch: Ground smooth.
 - c. Bolts Exposed to Touch in Travel Area: No nuts or screw threads exposed to touch.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 Metal Stairs With Grating Treads

- A. Jointing and Finish Quality Level: Industrial, as defined above.
- B. Risers: Open.
- C. Treads: Steel bar grating.
 1. Grating Type: Welded.
 2. Bearing Bar Depth: 1 inch, minimum.
 3. Nosing: Checkered plate.

- 4. Nosing Width: 1-1/4 inch, minimum.
- 5. Anchorage to Stringers: End plates welded to grating, bolted to stringers.
- D. Stringers: Rolled steel channels.
 - 1. Stringer Depth: 10 inches.
 - 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- E. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity or as detailed.
- F. Railings: Steel pipe railings.
- G. Finish: Shop- or factory-prime painted.

2.03 Handrails and Guards

- A. Wall-Mounted Rails: Round pipe rails unless otherwise indicated.
 - 1. Outside Diameter: 1-1/4 inch.
- B. Guards:
 - 1. Top Rails: Round pipe rails unless otherwise indicated.
 - a. Outside Diameter: 1 1/2 inch.
 - 2. Infill at Pipe Railings: Pipe rails sloped parallel to stair.
 - a. Pipe Outside Diameter: 1 1/2 inch.
 - b. Material: Steel pipe, round.
 - c. Vertical Spacing: Maximum 21 inches on center.
 - d. Jointing: Welded and ground smooth and flush.
 - 3. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: As indicated on drawings.
 - b. Mounting: Welded to top surface of stringer.

2.04 Materials

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.
- C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
- D. Gratings: Bar gratings complying with NAAMM MBG 531 or NAAMM MBG 532, whichever applies based on bar sizes.
- E. Steel Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.

- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.05 Shop Finishing

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
 - 2. Number of Coats: One.
- D. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A 123/A 123M.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

Part 3 Execution

3.01 Examination

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 Preparation

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 Installation

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

End of Section

Section 05 5200

Guardrails and Handrails

Part 1 General

1.01 Scope of Work

- A. Furnish and install custom aluminum railing system, and fittings, as shown on the Drawings. Railings on open side(s) of stairs shall be handrail/guardrail combination as detailed. Handrails shall be provided on both sides of stairs whether or not stair has accompanying guardrail on the open side.
- B. Guardrails for equipment platforms shall be as shown on the Drawings and specified herein.
- C. New installed system shall match existing system installed in the Sludge Handling Building as close as practical in profile and configuration.

1.02 Related Work Specified Elsewhere

- A. Section 07 9200: Joint Sealants

1.03 Quality Assurance

- A. Reference Standards
 - 1. ADA - Americans with Disabilities Accessibility Standards.
 - 2. AWS D1.2 - American Welding Society.
 - 3. ASTM B211 - Aluminum-Alloy Bars, Rods, and Wire.
 - 4. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
 - 5. ASTM B241 - Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - 6. ASTM B483 - Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
 - 7. ASTM E935 - Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - 8. ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.
 - 9. NAAMM – National Association of Architectural Metal Manufacturers.
 - 10. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- B. Inspection:
 - 1. Work done in accordance with this specification shall be subject to inspection. OWNER/ENGINEER shall have access to all places of manufacture where materials are being produced or fabricated, or where tests are being conducted and shall be accorded full facilities for inspection and observation.

1.04 Submittals

- A. Shop Drawings and Product Data:
 - 1. Shop Drawings: Show complete layout, plan view, elevations, connections, details for fabrication and attachment to other elements and other installation details.
 - a. Include calculations signed and sealed by a State of Michigan Registered Professional responsible for the structural design of the railing system.

1.05 Delivery, Storage and Handling

- A. Deliver materials in protective packaging to avoid damage or staining of the materials and finishes.
- B. Store materials properly and in accordance with the manufacturer's recommendations to avoid damage from moisture, abrasion and other construction activities.
- C. Avoid excessive handling of materials at the job site.

Part 2 Products

2.01 Design Requirements

- A. Railing assemblies, wall rails, and attachments shall be designed to meet the requirements from the latest State of Michigan Building Code without damage or permanent set. Test in accordance with ASTM A935.
- B. Allow for thermal action from a maximum range in ambient temperatures in the design, fabrications and installation of the railing system to prevent opening of joints, buckling, and other detrimental effects including over-stressing of connections and components.
- C. Prevent galvanic action and other forms of corrosion by isolating dissimilar metals, preventing direct contact with each other.
- D. Provide guardrail/handrail system and component parts from one source to assure consistency in quality and appearance.
- E. Guardrail/handrail system shall be fabricated and delivered to the site in the largest sections practical to minimize the number of field joints.

2.02 Materials

- A. Aluminum:
 - 1. Extruded tubing or pipe - Alloy 6063-T5 or T6 meeting ASTM B221.
 - 2. Reinforcing bars - Alloy 6061-T6 or T5 Meeting ASTM B-221.
 - 3. Extruded bars, shapes and moldings - Alloy 6063-T52 meeting ASTM B-221.
 - 4. Fasteners – Series 300 stainless steel.
 - 5. Finish – Clear brushed anodized (light circumferentially brushed before anodizing) AA-M32-C22-A41.

2.03 Aluminum Railing System

- A. Rails and Posts: Nominal 1-1/2 inch (38 mm) diameter, minimum schedule 40 aluminum pipe.
- B. Fittings: Elbows, T-shapes, brackets, etc., aluminum – flush with rail system.
- C. Mounting: Brackets, post receiver and flanges from same material as railing system.
- D. Splice Connectors: Concealed, non-welded, aluminum – clear anodized finish. Exposed connectors are not permitted. Railing surface shall be smooth, continuous through the use of concealed splice connectors.
- E. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- F. Toe Board: Extruded aluminum, channel shape or fabricated with stiffening ribs – flat aluminum stock is not acceptable.
- G. Aluminum Surfaces: Clear anodized finish.
- H. Apply one coat of bituminous paint per Section 09 9000 to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.04 Fabrication

- A. Fabricate railing system to comply with the manufacturer's printed requirements, project design requirements, details, dimensions, finish, member sizes, including post spacing and anchorage, but not less than the structural requirements to support loading.
- B. In no case shall post spacing exceed 6'-0" between members.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Factory joints shall be coped and tig welded by certified welders (AWS D1.2). Welds to be ground smooth prior to finishing.
- E. Provide anchors, required for connecting railings to structure.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- H. Assemble exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Accurately form components to each other and to building structure.
- J. Employ smooth curves by using radius elbows as opposed to mitering and welding.

- K. Where rail is mounted to concrete provide floor flange mounting at the base of each post.
- L. For removable railing, provide sleeves as detailed on the Drawings.
- M. Use appropriate end caps to close exposed open ends of all pipes.
- N. Accommodate for expansion and contraction of members and building movement without damage to connections or members.
- O. Provide weep holes or other means to exit water from hollow sections of the railing members, exposed to the exterior, condensation or moisture from other sources.

2.05 Manufacturers

- A. Julius Bloom & Co., Inc.
- B. Sterling Dula Architectural Products
- C. Superior Aluminum Products Inc.
- D. Wagner Enterprises.
- E. Golden Railing.

Part 3 Execution

3.01 Examination

- A. Examine system components, substrate and conditions where railing system is to be installed.
- B. Notify Engineer in writing of any unsatisfactory conditions prior to starting any of the work.

3.02 Preparation

- A. Prepare surrounding construction to receive railing system installations to comply with the manufacturer's printed instructions.
- B. Review and coordinate setting drawings, shop drawings, templates, and instructions for assembly and installation of the railing system and related items to be embedded in concrete or masonry.

3.03 Installation

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors.
- C. Install posts into concrete and fill hole with non-shrink, non-metallic grout to ½" below the finished surface.
- D. Provide continuous bead of sealant around posts to facilitate drainage away from posts.
- E. Conceal bolts and screws whenever possible.
- F. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

- G. Immediately upon completion of the installation clean all surfaces with clean water and a mild soap or detergent and rinse with clean water.
- H. Do not use acid solution, steel wool, or abrasives.

3.04 Erection Tolerances

- A. Maximum Variation from Plumb: 1/4 inch.
- B. Maximum Offset from True Alignment: 1/4.
- C. Maximum Out-of-Position: 1/4 inch.

End of Section

Division 07
Thermal and Moisture Protection

Section 07 1000 Dampproofing and Waterproofing

Part 1 General

1.01 Scope of Work

- A. This Section includes furnishing and applying thermal and moisture protection for the surfaces of structures constructed under this Contract, as indicated on the plans, including perimeter insulation, vapor barriers and damp proofing.

1.02 Submittals

- A. Submit manufacturer's literature of proposed products for review by ENGINEER in accordance with Section 01 3300.

1.03 Product Delivery, Storage, and Handling

- A. Unload and store in accordance with manufacturer's recommendations.

1.04 Environmental Requirements

- A. The temperature of the ambient air, surface and material during installation shall be in accordance with the manufacturer's recommendations.

Part 2 Products

2.01 Perimeter Insulation

- A. Use multi-cellular board of extruded polystyrene or polyurethane foam of thickness shown on the Plans; minimum compressive strength of 125 kPa; maximum water vapor transmission of 1.1 per inch; conforming to Federal Specification HH-I-524B, Type 11, Class B.

2.02 Vapor Barrier

- A. Use a 6-mil (150 μ m), polyethylene film.

2.03 Damp Proofing

- A. Use bituminous base for below grade surfaces and colorless, transparent nonstaining silicone compound for above grade surfaces.

2.04 Crystalline Waterproofing

- A. A cementitious crystalline type waterproofing material consisting of portland cement, silica sand and chemicals which chemically controls and permanently fixes non-soluble crystalline growth throughout the capillary voids of the concrete.

2.05 Acceptable Manufacturers

- A. Perimeter Insulation: Dow "Styrofoam"; United States Gypsum Company "Formula R"; or ENGINEER approved equal.
- B. Vapor Barrier: Polymeric "Visqueen"; "Durethane"; or ENGINEER approved equal.

- C. Crystalline Waterproofing: Xypex Concentrate or ENGINEER approved equal.

Part 3 Execution

3.01 Preparation

- A. Subgrade surfaces shall be smooth, free from voids, and sharp projections, and shall be to the lines and grades indicated on the Plans before vapor barrier, perimeter insulation, damp proofing, or waterproofing is installed.
- B. Prior to damp proofing or waterproofing, fill and finish flush with Portland cement mortar any cracks, holes, cavities or other surface defects.
- C. Clean surfaces of all dirt, dust, scale, laitance, curing compounds, oil, grease or other foreign material. Surfaces shall be dry and structurally sound. Apply grout coat of mortar to portions of brick and block surfaces to be backfilled against.

3.02 Installation of Perimeter Insulation

- A. Provide on foundation walls or under slabs as indicated on the Plans. Install and attach to walls as recommended by the manufacturer.

3.03 Installation of Vapor Barrier

- A. Provide under all floor slabs on subgrade as indicated on the Plans.
- B. Use widest practical, seamless width. Use 6-inch (150 mm) minimum laps with top lap placed in direction of concrete placement.
- C. Use extreme care in placing concrete reinforcement so as to not disturb or damage vapor barrier.
- D. Do not penetrate with stakes, concrete reinforcement or supports. Seal openings with tape in accordance with manufacturer's recommendations prior to concrete placement.

3.04 Installation of Damp Proofing

- A. Provide on the wet, exposed or backfilled side of all walls or slabs with wet, exposed-to-weather or backfill on one side and dry on the other side as indicated on the Plans.
- B. On backfilled surfaces use two (2) coats each applied at a rate of not less than 1-gallon per 100 square feet (4 L/10 m²) in accordance with manufacturer's recommendations. Use care to not permit material to get on any exposed surfaces. Remove such spillage or misapplication immediately. Allow material to thoroughly dry between coats and after final application.
- C. On exposed surfaces use two (2) coats each applied at a rate of not less than 1-gallon per 200 square feet (2 L/10 m²) in accordance with manufacturer's recommendations. Do not stain or discolor surfaces or allow runs or waves in applied material.

3.05 Installation of Crystalline Waterproofing

- A. Crystalline waterproofing shall be applied to green concrete or existing concrete which has been thoroughly saturated with clean water. Surfaces to be treated shall be moistened prior to application as required to insure proper migration of chemicals into the capillary voids in the concrete.

- B. Waterproofing material shall be mixed by volume with clean water which is free from salt or other deleterious materials. Waterproofing material shall be mixed in accordance with manufacturer's instructions.
- C. After repairs, patching and sealing has been done in accordance with manufacturers requirements, the concrete surfaces shall have a slurry of crystalline waterproofing applied in two coats at a rate of 1.5 lbs/syd per coat (8 kg/10 m²).
- D. Curing shall begin as soon as the waterproofing material has set up. Treated surfaces shall be fog sprayed three times a day for a three day period, or may be covered with damp burlap for three days.
- E. Crystalline Waterproofing may also be applied by mixing an approved admixture into the fresh concrete, according to the manufacturer's directions, at the time of placing concrete.

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 edges, formed metal trim pieces, preformed roof flashings and miscellaneous sheet metal accessories.

1.02 Related Work Specified Elsewhere

- A. Section 05 1200: Structural Steel Framing

1.03 Standard References

- A. American Iron and Steel Institute (AISI):
 - 1. Stainless Steel – Uses in Architecture
- B. American National Standards Institute (ANSI):
 - 1. ANSI/SPRI RD-1 - Standard for Retrofit Roof Drains
- C. American Welding Society (AWS):
 - 1. AWS D1.2/D1.2M - Structural Welding Code - Aluminum
- D. 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
- E. National Roofing Contractors Association (NRCA):
1. Roofing Manual
- F. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
1. Architectural Sheet Metal Manual

1.04 Submittals

- A. Product Data:
1. Manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.
- B. Submit a minimum of two (2) samples:
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, including installation of roofing materials. 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; 0.040-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 waterproof 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, non-expansion 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.

2.02 Finish

- A. Finish: Clear anodic coating, AA-M12C22A41 Class I mechanical finish, non-specular with medium-matte chemical etches and a minimum thickness of 0.7 mil (0.018 mm).
- B. Back paint concealed metal surfaces as specified for dissimilar metal protection on aluminum flashings and fabrications.

Part 3 Execution

3.01 Examination

- A. Verify roof openings, pipes, sleeves, ducts, or vents through roof are solidly set.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 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. 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.
- D. 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.
- E. Flashing for Roof Penetrations:
 - 1. Flashing of roof penetrations shall be as required by roofing manufacturer, in compliance with roof warranty requirements.

3.03 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

Section 07 9200 Joint Sealants

Part 1 General

1.01 Scope of Work

- A. Section covers sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.
- B. Section includes sealants for the following applications, including those specified by reference to this Section:
 - 1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:
 - a. Control and expansion joints in unit masonry or concrete.
 - b. Perimeter joints between materials listed above and frames of doors and windows.
 - c. Other joints as indicated.
 - 2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - d. Joints on underside of precast beams and planks.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - g. Other joints as indicated.

1.02 Reference Standards

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM C509 - Elastomeric Cellular Preformed Gasket and Sealing Material.
 - b. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

- c. ASTM C717 - Standard Terminology of Building Seals and Sealants.
- d. ASTM C834 - Latex Sealants.
- e. ASTM C919 - Use of Sealants in Acoustical Applications.
- f. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- g. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- h. ASTM D1667 - Standard Specification for Flexible Cellular Materials-- Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

1.03 Submittals

- A. Submit the following in accordance with Section 01 3300, Submittal Procedures:
 - 1. Product Data: For each joint-sealant product indicated.
 - 2. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
 - 3. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

1.04 Quality Assurance

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.05 Delivery, Storage, and Handling

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 Project Conditions

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.

2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees Fahrenheit (4.4 degrees Celsius).
 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.07 Warranty

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.
- D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

Part 2 Products

2.01 Performance Requirements

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.
- C. Joint sealant used in concrete water storage tanks or otherwise in contact with potable water shall be NSF 61 approved.

2.02 Materials, General

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.
- C. Approvals: Joint sealant and other materials used in concrete water storage tanks or otherwise in contact with potable water shall be NSF 61 approved.

2.03 Elastomeric Joint Sealants

- A. Elastomeric Sealant Standard: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C920 classifications for type, grade, class, and uses.
- B. Stain-Test Response Characteristics: Where elastomeric sealants are specified in Elastomeric Joint Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.04 Latex Joint Sealants

- A. Latex Sealant Standard: Comply with ASTM C834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.05 Joint-Sealant Backing

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 degrees Fahrenheit (minus 32 degrees Celsius). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.06 Miscellaneous Materials

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

Part 3 Execution

3.01 Examination

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Preparation

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 1. Remove foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 Installation of Joint Sealants

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
- E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.
- G. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.04 Field Quality Control

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
- B. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
1. Test Method: Test joint sealants by hand-pull method described below:
 - a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting crosscut at one end. Place a mark 1-inch (25 mm) from cross-cut end of 2-inch (50-mm) piece.
- C. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
- D. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
 2. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.

- b. Whether sealants filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
- 3. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
- 4. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
- E. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 Cleaning

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 Protection

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.
- B. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.07 Elastomeric Joint-Sealant Schedule

- A. Multicomponent Nonsag Polysulfide Sealant; Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Available products include the following:
 - a. CM-60; W.R Meadows, Inc.
 - b. T-2235-M; Morton International, Inc.
 - c. T-2282; Morton International, Inc.
 - d. Thiokol 2P; Morton International, Inc.
 - e. GC-5 Synthacalk; Pecora Corporation.
 - f. Two-Part Sealant; Sonneborn Building Products Div., ChemRex Inc.
 - 2. Type and Grade: M (multicomponent) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).

5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Coated glass, galvanized steel, brick, ceramic tile, and wood.

3.08 Latex Joint-Sealant Schedule

- A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
- B. Products: Available products include the following:
 1. Chem-Calk 600; Bostik Inc.
 2. NuFlex 330; NUCO Industries, Inc.
 3. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
 4. AC-20; Pecora Corporation.
 5. PSI-701; Polymeric Systems, Inc.
 6. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
 7. Tremflex 834; Tremco.

End of Section

Division 08
Openings

Section 08 1613.13

FRP Flush Panel Doors and Aluminum Frames

Part 1 General

1.01 Section Includes

- A. Flush fiber reinforced polyester doors.
- B. Flush fiber reinforced polyester panels.
- C. Aluminum door frames.

1.02 Related Work Specified Elsewhere

- A. Section 04 2000: Unit Masonry
- B. Section 07 9200: Joint Sealants
- C. Section 08 7100: Door Hardware

1.03 Reference Standards

- A. Aluminum Association, Inc. (AA).
 - 1. AA 6061-T6 – Heavy Duty Structures.
 - 2. AA 6063-T5 – Extrusions, Pipe, Architectural.
 - 3. AA DAF-45 – Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association (AAMA).
 - 1. AAMA 2605-98 – Superior Performing Organic Coatings (Kynar).
 - 2. AAMA 609 – Anodized Architectural Finishes Cleaning and Maintenance.
 - 3. AAMA 610.02 – Painted Architectural Products Cleaning and Maintenance.
 - 4. AAMA 611-98 – Anodized Architectural Standards.
 - 5. AAMA 701 – Pile Weather-strip.
 - 6. AAMA 1304 – Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems.
 - 7. AAMA 1503-98 – Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- C. American Society for Testing Materials (ASTM).
 - 1. B 209 –Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. B 221 –Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. C 591-01 – Unfaced Preformed Rigid Cellular Polyisocyanurate.
 - 4. D 256-97 – Izod Pendulum Impact Resistance of Plastics.
 - 5. D 570-98 – Water Absorption of Plastics.
 - 6. D 1242-95a – Resistance of Plastic Materials to Abrasion.
 - 7. D 1621 –Compressive Properties of Rigid Cellular Plastics.
 - 8. D 1622 – Apparent Density of Rigid Cellular Plastics.
 - 9. D 1623 – Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
 - 10. D 2126 – Rigid Cellular Plastics to Thermal and Humid Aging.
 - 11. D 2583-95 – Indentation Hardness of Rigid Plastics (Barcol Impressor).
 - 12. D 3841-97 – Glass-Fiber-Reinforced Polyester Plastic Panels.

13. E 84-99 – Surface Burning Characteristics.
 14. E 330-02 – Structural Performance of Exterior Doors.
 15. E 331-00 – Water Resistance.
 16. E 283-91 – Air infiltration.
- D. Florida Building Code; Dade County Building Codes
1. TAS-201-95.1 – Impact Test Procedures (Inclusive of Large Missile Impact).
 2. TAS-202-95.1 – Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure.
 3. TAS-203-95.1 – Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.
- E. International Building Code Compliant:
1. Section 2603.4.1.7 – Doors not required to have a fire protection rating. Foam core has a Class “A” rating covered with 0.032 aluminum skins. Outer FRP skin also carries a Class “A” Rating for flame spread and smoke development.

1.04 Testing and Performance Requirements

- A. Meets or exceeds ICC Building Code Standards.
- B. FRP Panels shall be USDA accepted.
- C. Manufacturer to supply test data certification upon request.

1.05 Submittals

- A. Submit under provisions of Section 01 3300, Submittal Procedures.
- B. Product Data: Manufacturer’s descriptive literature for each type door and frame; include the following information:
 1. Fabrication methods.
 2. Finishing.
 3. Hardware preparation.
 4. Accessories.
- C. Shop Drawings: Indicate the following:
 1. Elevations and details of each door and frame type.
 2. Schedule of doors and frames.
 3. Location and installation requirements for hardware.
 4. Thickness of materials, joints.
 5. Connections and trim.
- D. Samples: Two sets of color chips representing specified colors and finishes shall be furnished upon request.
- E. Verification Samples:
 1. Submit samples of each type consisting of aluminum-member FRP door corner construction, minimum 6-inch by 6-inch (150 mm) shall be furnished upon request.

2. When color or texture variations are anticipated, such as anodized finishes, include two or more units in each set of samples indicating extreme limits of variations.
- F. Hardware Templates: Provide finish hardware mounting details.
- G. Manufacturer's Installation Instructions: Printed installation instructions for each product, including product storage requirements.
- H. Operations and Maintenance Data: Printed instructions for each product.

1.06 Quality Assurance

- A. Referenced Standards:
 1. Door Assembly:
 - a. ASTM C 518 Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.
 - b. Wind-load test certification conforming to TAS 202-95.1 and ASTM E 330 on samples of previous products shall be provided for the type of door to be used.
- B. Qualifications:
 1. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 25 years of documented experience and with a record of successful in-service performance for the applications as required for this project.
 2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.
 3. Surface Limitations: Obtain fiberglass reinforced plastic doors and frames through one source fabricated from a single manufacturer.
 4. Source Limitations: Hardware and accessories for all FRP doors as specified in Section 08710 should be provided and installed by the fiberglass door and frame manufacturer.

1.07 Delivery, Storage and Handling

- A. Delivery of doors and frames to be palletized or individually crated. Doors shall be side protected with surrounding grooved 2-inch (50.8 mm) by 4-inch (101.6 mm) wood frame and covered with 275-pound (124.74 kg) test corrugated cardboard.
- B. Unload and store with minimum handling. Inspect delivered doors and frames for damage. Minor damaged items may be repaired. If items cannot be repaired to equal in all respects to new work; remove damaged items and replace with new.
- C. Store products of this section under cover in manufacturer's unopened packaging until installation.

1. Place units on minimum 4-inch (100.6 mm) wood blocking.
2. Avoid non-vented plastic or canvas covers.
3. Remove packaging immediately if packaging becomes wet.
4. Provide 1/4-inch (6.35 mm) air spaces between stacked doors.

1.08 Project Conditions

- A. Field Measurements: Take field measurements of areas to receive aluminum frames; note discrepancies on submitted shop drawings.

1.09 Scheduling

- A. Ensure that all approvals and/or shop drawings are supplied or returned to the manufacturer in time for fabrication without affecting construction progress schedule.
- B. Ensure that templates and/or actual hardware requested by manufacturer are available in time for fabrication without affecting construction progress schedule.

1.10 Warranty

- A. Manufacturer:
 1. Warrant doors, frames, and factory installed hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.
 2. Standard Period:
 - a. Ten years starting on date of shipment.
 3. Limited Lifetime:
 - a. Covers failure of corner joinery, core deterioration, and delamination or bubbling of door skin and corrosion of all-fiberglass products while the door is in its specified application in its original installation.
 4. Finish:
 - a. Kynar painted aluminum: 10 years.
 - b. FRP face sheets: 5 years.
 - c. Anodized, aluminum: 10 years.
- B. Installer: Warrant installation procedures and performance for five years against defects due to workmanship and materials handling.

Part 2 Products

2.01 Manufacturers

- A. Special-Lite, Inc., PO Box 6, Decatur, MI; (800) 821-6531; www.special-lite.com
- B. Substitutions shall be subject to the provisions of Section 01 3300.

2.02 Components

- A. SL-20 Sandstone Texture FRP/ Aluminum Hybrid Door:

1. Door Thickness: 1-3/4-inches
2. Stiles & Rails:
 - a. Aluminum extrusions made from 6063 aluminum alloys with a minimum temper of T5.
 - b. Minimum 2-5/16-inches deep one-piece extrusion with have integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place and permit flush appearance.
 - c. Screw or snap in place applied caps are not acceptable.
 - d. Top rails must have integral legs for interlocking continuous extruded aluminum flush cap.
 - e. Bottom rails must have integral legs for interlocking continuous weather bar with single nylon brush weather stripping or manually adjustable SL-301 door bottom with two nylon brush weather stripping.
 - f. Meeting stiles to include integral pocket to accept pile brush weather seal.
3. Corners:
 - a. Mitered.
 - b. Secured with 3/8-inch diameter full-width steel tie rod through extruded splines top and bottom which are integral to standard tubular shaped rails.
 - c. 1-1/4-inch x 1-1/4-inch x 3/16-inch 6061 aluminum angle reinforcement at corner to give strong, flat surface for locking hex nut to bear on.
 - d. Weld, glue, or other methods of corner joinery are not acceptable.
4. Core:
 - a. Poured-in-place polyurethane foam.
 - b. Laid in foam cores are not acceptable.
 - c. Core Liner: Foam core of door shall be completely covered on interior and exterior sides of core with contiguous sheets of 0.032 (0.81mm) thick aluminum.
5. Face Sheet:
 - a. Exterior
 - (1) 0.120-inch thick, Sandstone texture, through color FRP sheet.
 - (2) Class C.
 - (3) UV protected – Ultraviolet inhibitors shall be maximum amount formulated with the resin.

- b. Interior:
 - (1) 0.120-inch thick, Sandstone texture, through color FRP sheet.
 - (2) Class A.
 - c. Attachment of Face Sheet:
 - (1) Extruded stiles and rails to have integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place and permit flush appearance.
 - (2) Use of glue to bond face sheet to core or extrusions is not acceptable.
- 6. Cutouts:
 - a. Manufacture doors with cutouts for required vision lites, louvers, and panels.
- 7. Hardware:
 - a. Pre-machine doors in accordance with templates from specified hardware manufacturers.
 - b. Surface mounted closures will be reinforced for but not prepped or installed at factory.
 - c. Factory install door hardware.
- 8. Reinforcements:
 - a. Aluminum extrusions made from 6063 aluminum alloys.
 - b. Sheet and plate to conform to ASTM-B209.
 - c. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.
 - d. Bars and tubes to meet ASTM-B221.
- B. Thermally Broken Aluminum Framing:
 - 1. Materials:
 - a. Aluminum extrusions made from 6063 aluminum alloys.
 - b. Sheet and plate to conform to ASTM-B209.
 - c. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.
 - 2. Perimeter Frame Members:
 - a. Storefront frame with thermally broken pocket filler.
 - b. Factory fabricated.
 - c. Open-back framing is not acceptable.

3. Thermal Strut:
 - a. Fiber reinforced plastic, no other materials will be accepted.
4. Applied Door Stops:
 - a. 5/8-inch x 1-1/4-inch or 5/8-inch x 1-3/4-inch, 0.125-inch wall thickness, with screws and weather-stripping.
 - b. Provide solid 1/2" aluminum bar behind door stop for closer shoe attachment.
 - c. Pressure gasketing for weathering seal.
 - d. Counterpunch fastener holes in door stop to preserve full-metal thickness under fastener head.
 - e. Minimum 1/2-inch aluminum bar reinforcement under doorstep for required hardware attachments, aluminum to meet ASTM-B221.
5. Caulking.
 - a. Caulk joints before assembling frame members.
6. Frame Member to Member Connections.
 - a. Secure joints with fasteners.
 - b. Provide hairline butt joint appearance.
 - c. Shear block construction only, no screw spline allowed.
7. Hardware
 - a. Pre-machine and reinforce frame members for hardware in accordance with manufacturer's standards and door hardware schedule.
 - b. Surface mounted closures will be reinforced for but not prepped or installed at factory.
 - c. Factory install door hardware.
8. Anchors:
 - a. Anchors appropriate for wall conditions to anchor framing to wall materials.
 - b. Door Jamb and Header Mounting Holes: Maximum of 24-inch centers.
 - c. Secure head and sill members of transom, side lites, and similar conditions.

C. Glazing:

1. Glass shall be 1-inch (25 mm) insulated, Low-E, tempered.
2. Stops shall be snap-in, non-removable type, 6063-T5 extruded aluminum alloy, 0.050-inch (1.25 mm) thickness.
3. Seals shall be vinyl inserts.

4. No fasteners shall be exposed.

2.03 Finishes

- A. Aluminum:
 1. Anodizing: Class 1 Anodizing, minimum 0.7 mils thick.
 2. Color: Clear 215 R1, AA-M10C12C22A41.
- B. FRP Face Sheets:
 1. Through Color to be selected from Mfr. full range of available colors.

2.04 Fabrication

- A. General: Receive hardware if required by manufacturer.
- B. Flush Fiberglass Reinforced Polyester Door Construction: Of type, size and design indicated.
- C. Aluminum Frames: Of shapes and contours indicated.
 1. Corners shall be cut square.
 2. Reinforced and secured mechanically.
 3. No exposed fasteners.

2.05 Accessories

- A. Fasteners: Aluminum, nonmagnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
 1. No exposed fasteners.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, nonferrous stainless steel.
- C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil (0.76 mm) thickness per coat.

Part 3 Execution

3.01 Examination

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.

3.02 Preparation

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions without damage to sight-exposed finishes.
- B. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 Installation

- A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings; set frames plumb, square, level, and aligned to receive doors.
- B. Anchor frames to adjacent construction in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
 - 1. Seal metal-to-metal joints between framing members using good quality elastomeric sealant.
- C. Where aluminum surfaces contact with metals other than stainless steel, zinc or small areas of white bronze, protect from direct contact by one or more of the following methods.
 - 1. Paint dissimilar metal with one coat of heavy-bodied bituminous paint.
 - 2. Apply good quality elastomeric sealant between aluminum and dissimilar metal.
 - 3. Paint dissimilar metal with one coat of primer and one coat of paint recommended for aluminum surface applications.
 - 4. Use non-absorptive tape or gasket in permanent dry locations.
- D. Hang doors with required clearances as follows:
 - 1. Hinge and Lock Stiles: 0.125-inch (3.17 mm).
 - 2. Between Meeting Stiles: 0.250-inch (6.34 mm).
 - 3. At Top Rails: 0.125-inch (3.17 mm).
 - 4. Between Door Bottom and Threshold: 0.125-inch (3.17 mm).
- E. Adjust doors and hardware to operate properly.
- F. Install glazing in glazing frames.
- G. Install hardware for doors of this section.
- H. Installation of door hardware is specified in Section 08 7100.

3.04 Cleaning

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609.
- B. Do not use abrasive, caustic or acid cleaning agents.

3.05 Protection

- A. Protect products of this section from damage caused by subsequent construction.
- B. Repair damaged or defective products to original specified condition in accordance with manufacturer's recommendations.
- C. Replace damaged or defective products, which cannot be repaired to Architect's acceptance.

End of Section

Section 08 3323 Overhead Coiling Doors

Part 1 General

1.01 Summary

- A. Insulated overhead coiling door, motorized operator and controls.
 - 1. Controls for the door shall be coordinated with the Electrical requirements of these Specifications.
 - 2. Coiling Door: Surface mounted

1.02 Related Work Specified Elsewhere

- A. Section 05 5000: Metal Fabrications: Support framing.
- B. Section 26 0510: Basic Electrical Materials and Methods: Conduit, wire and methods as they pertain to the electric circuit to door operator and from door operator to control station.

1.03 Reference Standards

- A. ASTM International:
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 System Description

- A. Electric Operation: Electric motor operated unit with manual chain operation override in case of power failure.

1.05 Design Requirements

- A. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa), with maximum deflection of 1/120, and without damage to [door] [shutter] or assembly components.
- B. Operation: Design door assembly including operator, to operate for not less than 20,000 cycles and 10 cycles per day.

1.06 Submittals

- A. Submittals shall be in accordance with Section 01 3300, Submittal Procedures.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

- C. Product Data: Submit general construction, component connections and details, wiring diagram and electrical equipment.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

1.07 Closeout Submittals

- A. Execution and Closeout Requirements in accordance with Section 01 7700, Closeout Procedures.
- B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

Part 2 Products

2.01 Overhead Coiling Doors

- A. Manufacturers:
 - 1. Overhead Door Corp, Model 625 (Basis of Design).
 - 2. Raynor Garage Doors, Model DuraCoil Optima.
 - 3. Wayne Dalton model similar to above.
 - 4. Substitutions per Section 01 2513, Substitution Procedures.

2.02 Components

- A. Overhead Coiling Stormtite Insulated Service Doors: Overhead Door Corporation Model 625.
 - 1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
 - b. Front slat fabricated of:
 - (1) Aluminum .040 inch (1 mm).
 - c. Back slat fabricated of:
 - (1) Aluminum .024 inch (.06 mm).
 - d. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.
 - (1) R-Value: 7.7, U-Value: 0.13.
 - (2) Sound Rating: STC-21.
 - 2. Performance:
 - a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
 - b. Installed System Sound Rating: STC-21 as per ASTM E 90.
 - c. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.

- d. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft².
- 3. Slats and Hood Finish:
 - a. Aluminum: Slats and hood shall be aluminum finished as follows.
 - (1) Finish: Clear anodized finish.
- 4. Weatherseals:
 - a. Vinyl bottom seal, exterior guide and internal hood seals.
- 5. Bottom Bar:
 - a. Extruded aluminum angle minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
- 6. Guides: Three structural steel angles.
- 7. Brackets:
 - a. Stainless steel to support counterbalance, curtain and hood.
- 8. Finish; Bottom Bar, Guides, Headplate and Brackets:
 - a. Finish: PowderGuard Premium powder coat color as selected by the Architect.
- 9. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
- 10. Hood: Provide with internal hood baffle weatherseal.
 - a. Aluminum hood with intermediate supports as required.
- 11. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - a. Sensing Edge Protection:
 - (1) Electric sensing edge.
 - b. Operator Controls:
 - (1) Push-button operated control stations with open, close, and stop buttons.
 - (2) Controls for interior location.
 - (3) Controls surface mounted.
 - c. Motor Voltage: 115/230 single phase, 60 Hz.
- 12. Windload Design:
 - a. Standard windload shall be 20 PSF.

13. Locking:
 - a. Chain keeper locks for chain hoist operation.
14. Wall Mounting Condition:
 - a. Face-of-wall mounting.
- B. Mechanical Disconnect Device:
 1. Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch.
 2. Provide electric door operator assembly with electric motor and factory-pre-wired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories, as specified below and as required for proper operation.
- C. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- D. Hardware: Door shall be fitted with a roller chain and sprocket operator for emergency operation.
- E. Weatherstripping (Exterior Assemblies): Moisture and rot proof, resilient type for complete weathertight installation.
- F. Safety Edge: Manufacturer's standard safety edge, intrinsically safe and weather seal located at door bottom, full width, sensitized type, wired to reverse upon striking object.

2.03 Electric Operator

- A. Description: UL 325 2010 compliant, side mounted, totally enclosed.
- B. Model: Overhead Door RHX or equal
- C. Motor Enclosure: TEFC
- D. Motor Rating: minimum 3/4 hp; continuous duty.
- E. Motor Voltage: 230/460 volt, three phase, 60 Hz.
- F. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
- G. Controller Enclosure: NEMA 12
- H. Brake: Adjustable friction clutch type, activated by motor controller.
- I. Control Station: Standard three button Open-Stop-Close momentary control for operator; 24 volt circuit; surface mounted.
- J. Provide adjustable limit switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- K. Wiring associated with the door shall be run in rigid galvanized conduit.
 1. This shall include all wiring from the control panel to the motor and remote devices.

2. Refer to Electrical Specifications for conduit requirements.

Part 3 Execution

3.01 Examination

- A. Administrative Requirements: Coordination and project conditions.
- B. Verify opening sizes, tolerances and conditions are acceptable.

3.02 Installation

- A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- B. Securely and rigidly brace components suspended from structure.
- C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- D. Coordinate installation of electrical service with Division 26. Complete wiring from disconnect to unit components and from fire alarm system to door operator.
- E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 9200, Joint Sealants.
- F. Install perimeter trim and closures.

3.03 Erection Tolerances

- A. Section 01 4500, Quality Controls: Tolerances.
- B. Maintain dimensional tolerances and alignment with adjacent Work.
- C. Maximum Variation From Plumb: 1/16 inch.
- D. Maximum Variation From Level: 1/16 inch.
- E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 Adjusting

- A. Execution and Closeout Requirements per Section 01 7700: Testing, adjusting, and balancing.
- B. Adjust door, hardware and operating assemblies for smooth and noiseless operation.
- C. Test smoke activated assemblies for proper activation.

3.05 Cleaning

- A. Section 01 7700, Closeout Procedures: Final cleaning.
- B. Clean door and components.
- C. Remove labels and visible markings.

End of Section

Section 08 4413

Glazed Aluminum Curtain Walls

Part 1 General

1.01 Section Includes

- A. Aluminum curtain wall systems, complete with reinforcing, shims, anchors and attachment devices.
- B. Accessories necessary to complete Work.

1.02 Related Work Specified Elsewhere

- A. Section 09 9900: Painting: Backcoating Dissimilar Metals

1.03 Reference Standards

- A. Aluminum Association (AA):
 - 1. DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. Aluminum Curtain Wall Design Guide Manual.
 - 2. Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
 - 3. 501.2 - Field Check of Metal Curtain Walls for Water Leakage.
 - 4. 503.1 - Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Systems.
 - 5. 605.2-92 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 6. 606.1 - Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
 - 7. 607.1 - Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
 - 8. 608.1 - Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
 - 9. 701.2 - Specifications for Pile Weatherstripping.
 - 10. Manual #10 - Care and Handling of Architectural Aluminum from Shop to Site.
 - 11. Manual #11 - Design Wind Loads for Buildings and Boundary Layer Wind Tunnel Testing.
 - 12. FC-1 - Field Check of Metal Curtain Walls for Water Leakage.
- C. American National Standards Institute (ANSI):
 - 1. Z97.1- Specifications and Methods of Test for Safety Glazing Material Used in Buildings.

- D. American Society for Testing and Materials (ASTM):
1. A36 - Structural Steel.
 2. B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 3. B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 4. B308 - Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
 5. C509 - Cellular Elastomeric Pre-formed Gasket and Sealing Material.
 6. C669 Glazing Compounds for Back Bedding and Face Glazing of Metal Sash.
 7. C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers.
 8. C804 Use of Solvent Release Type Sealants.
 9. C920 - Elastomeric Joint Sealants.
 10. C 1036 - Flat Glass.
 11. C 1048 - Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
 12. C 1376 - Pyrolytic and Vacuum Deposition Coatings on Glass.
 13. E283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
 14. E330 - Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 15. E331 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
 16. E 2188 - Insulating Glass Unit Performance.
 17. E 2190 - Insulating Glass Unit Performance and Evaluation.
- E. Federal Specifications (FS):
1. TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type.
- F. Flat Glass Marketing Association (FGMA):
1. Glazing Manual.
- G. ANSI Z97.1 Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
- H. CPSC 16CFR-1201 - Safety Standard for Architectural Glazing Materials.
- I. Glass Association of North America (GANA) Glazing Manual.

1.04 System Requirements

A. Design Requirements:

1. Metal stick framed systems with interior and exterior exposed metal framing.
2. System manufacturer shall provide curtain wall systems, including necessary modifications to meet specified requirements and maintaining visual design concepts.
3. Fabricate glazing systems for exterior glazing at vision areas. Provide custom sheet metal exterior frame extensions/caps at frame to match appearance of existing demolished window system.
4. Perimeter conditions shall allow for installation tolerances, expansion and contraction of adjacent materials, and sealant manufacturer's recommended joint design.
5. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage or moisture disposal.
6. Requirements shown by details are intended to establish basic dimension of unit, sight lines and profiles of members.
7. Do not assume glass, sealants and interior finishes contribute to framing member strength, stiffness or lateral stability.
8. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
9. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
10. Anchors, fasteners and braces shall be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
11. Allow for expansion and contraction without detriment to appearance or performance.
12. System shall drain to the exterior of system any water entering system.
13. Provide concealed fastening.
14. Metal faces are required to be visually flat under all lighting conditions, subject to acceptance of Architect.
15. Provide uniform color and profile appearance at components exposed to view.
16. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

B. Performance Requirements:

1. Air infiltration: Air leakage shall not exceed 0.06 cfm per square foot (0.0003 m³/sm²) of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (300 Pa).
2. Water infiltration: No uncontrolled water penetration when tested in accordance with ASTM E 331 at test pressure of 20.0 psf or 20 percent of full positive design wind load, whichever is greater.

C. Structural Requirements:

1. Wind loading:
 - a. 20 psf, in accordance with ASCE-7.
2. Deflection under uniform loading: When tested in accordance with ASTM E330 at design pressure, maximum deflection of exterior member shall not exceed 1/240 of span.
3. Deflection of members parallel to the plane of the wall, when carrying its full dead load, shall not exceed an amount that will reduce glass bite by less than 75 percent of the design dimension and shall not reduce edge clearance between itself and the panel, glass or other fixed member immediately below to less than 1/8 inch (3.2 mm).
4. Do not regard points of contraflexure as lateral braces or as end points of unbraced length; unbraced length is actual distance between effective lateral braces as defined above.
5. Where framing member reaction is resisted by continuous element, maximum assumed effective length of the resisting element is 4 times bearing length, but not more than 12 inches (305 mm).

D. Seismic Loads: Provide glazed aluminum curtain wall system, including anchorage, capable of withstanding the effects of earthquake motions as required by local Building Code requirements.

E. Thermal Requirements: Framing systems shall accommodate expansion and contraction movement due to surface temperature differential of 180 degree Fahrenheit (82 degree Celsius) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance or other detrimental effects.

F. Interface:

1. Furnish inserts and anchoring devices which need to be preset and built into structure to appropriate trade.
2. Supply on timely basis to avoid delay in Work.
3. Instruct other trades of proper location and position.
4. Furnish setting drawings, diagrams, templates and installation instructions.

1.05 Submittals for Review

A. Section 01 3300, Submittal Procedures: Procedures for submittals.

- B. Design Data: Provide system structural, physical and performance characteristics, calculations, and dimensional limitations. Designs must be prepared by a professional engineer, licensed in the State of Michigan.
- C. Shop Drawings:
 - 1. Submit drawings indicating elevations, detailed design, dimensions, member profiles, joint locations, arrangement of units and member connections.
 - 2. Show following items:
 - a. Details of special shapes.
 - b. Reinforcing.
 - c. Anchorage system.
 - d. Interfacing with building construction.
 - e. Provisions for expansion and contraction.
 - f. Thermal breaks.
 - 3. Indicate typical glazing details and internal sealant requirements as recommended by sealant manufacturer.
 - 4. Clearly indicate locations of exposed fasteners and joints for Architect's acceptance.
 - 5. Clearly show where and how manufacturer's system deviates from Contract Drawings and these Specifications.
 - 6. Indicate framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, and field welding or bolting required.
- D. Submit color charts for finish indicating manufacturer's full range of available colors.
- E. Submit glazing tint color samples for selection.
- F. Certificates:
 - 1. Submit manufacturer's certification stating that installed system is in compliance with specified requirements.
- G. Qualification Data:
 - 1. Submit installer qualifications verifying years of experience.
 - 2. Include list of projects having similar scope of work identified by name, location, date, reference name and phone number.

1.06 Quality Assurance

- A. Perform Work in accordance with AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual. AAMA - Aluminum Curtain Wall Design Guide Manual. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years' documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum ten years' experience.

- D. Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located. in the State of Michigan.

1.07 Regulatory Requirements

- A. Conform to applicable code for acoustic attenuation, minimum sound transmission, and requirements.

1.08 Mock-Up

- A. Section 01 4500, Quality Control: Requirements for mock-ups.
- B. Provide 2 feet x 5 ft (600 mm x 1500 mm) mockup including intermediate mullion, vision glass light, and panel. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- C. Mockup may remain as part of the Work.

1.09 Pre-Installation Meeting

- A. Convene one week before starting work of this section.

1.10 Delivery, Storage, And Protection

- A. Section 01 6000, Product Requirements: Transport, handle, store, and protect products.
- B. Deliver, handle and store work of this Section in accordance with AAMA - Curtain Wall Manual #10 and Manufacturer's instructions.
- C. Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation.

1.11 Environmental Requirements

- A. Section 01 6000, Product Requirements: Environmental conditions affecting products on site.
- B. Do not install sealants or glazing when ambient temperature is less than 50 degrees Fahrenheit.
- C. Maintain this minimum temperature before, during and 24 hours after installation of sealants and glazing compounds.

1.12 Warranty

- A. Provide written manufacturer's warranty, executed by company official, warranting against defects in materials and products for 2 years from date of Substantial Completion.
- B. Provide written installer's warranty, warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components which fail within 5 years from date of Substantial Completion.
 - 1. Warranty shall cover following:

- a. Complete watertight and airtight system installation within specified tolerances.
 - b. Completed installation will remain free from rattles, wind whistles and noise due to thermal and wind pressure.
 - c. System is structurally sound and free from distortion.
 - d. Glass and glazing gaskets will not break or "pop" from frames due to design windload pressure, expansion or contraction movement, or structural loading.
 - e. Glazing sealants and gaskets will remain free from abnormal deterioration or dislocation due to sunlight, weather or oxidation.
- C. Provide written warranty stating organic coating finish will be free from fading more than 10%, chalking, yellowing, peeling, cracking, pitting, corroding or non-uniformity of color, or gloss deterioration beyond manufacturer's descriptive standards for 5 years from date of Substantial Completion and agreeing to promptly correct defects.

Part 2 Products

2.01 Curtain Wall System

- A. Manufacturers:
 - 1. United States Aluminum – CRL 4500 Curtain Wall System (Basis of Design)
 - 2. Wausau Windows – Superwall Curtain Wall System
- B. Substitutions shall be subject to the provisions of Section 01 2513.

2.02 Framing Materials and Accessories

- A. Aluminum:
 - 1. ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 5005-H34 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish.
- B. Internal Reinforcing:
 - 1. ASTM A 36 for carbon steel; or ASTM B 308 for structural aluminum.
 - 2. Shapes and sizes to suit installation.
 - 3. Shop coat steel components after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645.
- C. Inserts and Anchorage Devices:
 - 1. Manufacturer's standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars or tubes.
 - 2. Shop coat steel assemblies after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645
- D. Fasteners:

1. Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be non-corrosive and compatible with components being fastened.
 2. Do not use exposed fasteners, except where unavoidable for application of hardware.
 3. For exposed locations, provide countersunk Phillips head screws with finish matching items fastened.
 4. For concealed locations, provide manufacturer's standard fasteners.
 5. Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is unacceptable.
- E. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.
- F. Shims: Non-staining, non-ferrous, type as recommended by system manufacturer.
- G. Protective Coatings: Cold applied asphalt mastic complying with SSPC-Paint 12, compounded for 30 mil (0.77 mm) thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.
- H. Glazing Gaskets:
1. Compression type design, replaceable, molded or extruded neoprene, or ethylene propylene diene monomer (EPDM).
 2. Comply with ASTM C509 or C864.
 3. Profile and hardness as necessary to maintain uniform pressure for watertight seal.
 4. Provide in manufacturer's standard black color.
 5. Factory molded corners required at exterior.
- I. Internal Sealants: Types recommended by sealant manufacturer to remain permanently elastic, tacky, non-drying, non-migrating and weathertight.
- J. "Anti-Walk" Edge Blocking: "W" shaped E.P.D.M. blocks for use in keeping glazing material stationary under vibration or seismic loading. Edge blocking may be used for pressure plate systems.

2.03 Glazing Materials

- A. Manufacturer:
1. Guardian Industries.
 2. PPG.
 3. Tempglass, Inc.
- B. Basis of Design – Guardian SN 68. Glass to be insulated, Low-E, 1-inch thick, metal edge sealed units. Tint to approximate existing glazing being demolished. Verify exact color in field with ENGINEER and OWNER – color to be selected from manufacturer's full range of available colors. Provide safety glazing in all locations required by the Michigan Building Code.

2.04 Sealant Materials

- A. Sealant and Backing Materials: As specified in Section 07 900 of types described below and in accordance with all Mfr. recommendations for the installation.

2.05 System Fabrication

- A. Take accurate field measurements to verify required dimensions prior to fabrication.
- B. Location of exposed joints are subject to Architect's acceptance.
- C. Provide rigid, thermal break isolators to prevent exterior and interior aluminum framing members from being in contact with each other.
- D. Fabricate components in accordance with approved shop drawings. Remove burrs and smooth edges. Shop fabricate to greatest extent practicable to minimize field cutting, splicing and assembly. Disassemble only to extent necessary for shipping and handling limitations.
- E. Steel Components:
 - 1. Clean surfaces after fabrication and immediately prior to application of primer in accord with SSPC-SP2 or SSPC-SP3 at manufacturer's option.
 - 2. Apply specified shop coat primer in accord with manufacturer's instructions to provide 2.0 mil (0.050 mm) minimum dry film thickness.
- F. Fabricate components true to detail and free from defects impairing appearance, strength or durability. Fabricate custom extrusions indicated and as necessary for complete installation.
- G. Fabricate components to allow for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush and weathertight. Ensure slip joints make full, tight contact and are weathertight.
- H. Reinforce components as required at anchorage and support points, at joints, and at attachment points for interfacing work.
- I. Provide structural reinforcing within framing members where required to maintain rigidity and accommodate design loads. Provide all necessary structural clips and components as required to support off of existing building framing.
- J. Provide holes or slots, deflector plates, water deflectors, and sealants to accommodate internal weep and drainage to the exterior of curtain wall system.
- K. Allow for adequate clearance around perimeter of system to enable proper installation and for thermal movement within system.
- L. Separate dissimilar metals with protective coating or pre-formed separators to prevent contact and corrosion.
- M. Provide special shapes and filler pieces with tight corners. Appearance of Curtainwall system is to closely match existing system that is being demolished – provide custom metal caps, struts, supports and connectors as required to match existing frame proportions and depth.

2.06 Finishes

- A. Organic Coating (high performance fluoropolymer):
 - 1. Comply with requirements of AAMA 605.2-92.
 - 2. Surfaces cleaned and given conversion coating pre-treatment prior to application of 0.3 mil (0.0076 mm) dry film thickness of epoxy or acrylic primer following recommendations of finish coat manufacturer. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.
 - 3. Finish coat of 70 percent minimum fluoropolymer resin fused to primed surfaces at temperature recommended by manufacturer, 1.0 mil (0.25 mm) minimum dry film thickness.
 - 4. Acceptable coating manufacturer's: PPG Industries Inc. and The Valspar Corporation.
 - 5. Provide in either 2, 3, or 4 coat system as required for color selected.
 - 6. Custom color as selected by ENGINEER. Provide samples for review and approval.

Part 3 Execution

3.01 Examination

- A. Verification of existing conditions before starting work.
- B. Verify dimensions, tolerances, and method of attachment with other work.

3.02 Installation

- A. Install curtain wall system in accordance with manufacturer instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Provide attachments and shims to permanently fasten system to building structure.
- G. Anchor securely in place, allowing for required movement, including expansion and contraction.
- H. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with protective coating or pre-formed separators to prevent contact and electrolytic action.

- I. Seal perimeter members as shown on manufacturer's installation instructions or as required for unique job conditions. Set other members with internal sealants and baffles as called for in manufacturer's installation instructions. Use sealants as recommended by sealant manufacturer.
- J. Provide adequate support for all the aluminum frames, glass deadloads, and for the end reactions to specified windloads.
- K. Install glass in accordance with manufacturer's instructions, except where local codes or GANA Glazing Manual indicate more stringent requirements.
- L. Install sill and flashings.
- M. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.
- N. Utilize "anti-walk" edge blocking on all vertical edges of glazing.
- O. Install perimeter sealant to method required to achieve performance criteria. in accordance with Section 07 9200.

3.03 Erection Tolerances

- A. Section 01 4500, Quality Control: Tolerances.
- B. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.
- C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- D. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch (19 mm) and minimum of 1/4 inch (6 mm).

3.04 Field Quality Control

- A. Section 01 4500, Quality Control
- B. Inspection will monitor quality of installation and glazing.

3.05 Manufacturer's Field Services

- A. Curtain wall product manufacturers to provide field surveillance of the installation of their Products.
- B. Monitor and report installation procedures, unacceptable conditions.

3.06 Cleaning

- A. Section 01 7700, Closeout Procedures: Cleaning installed work.
- B. Remove protective material from prefinished aluminum surfaces.
- C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.07 Protection of Finished Work

- A. Section 01 7700, Closeout Procedures: Protecting installed work.
- B. Protect finished Work from damage.

End of Section

Section 08 7100 Door Hardware

Part 1 General

1.01 Section Includes

- A. Hardware for hollow steel doors.
- B. Thresholds.
- C. Weatherstripping, seals and door gaskets.

1.02 Related Sections

- A. Section 01 7700: Closeout Procedures: Turning keys over to the Owner; tagging keys.
- B. Section 08 1613.13: FRP Flush Panel Doors and Aluminum Frames

1.03 Reference Standards

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- B. NFPA 80 - Fire Doors and Windows.
- C. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
- D. NFPA 252 - Fire Tests of Door Assemblies.
- E. UL 10B - Fire Tests of Door Assemblies.
- F. UL 305 - Panic Hardware.

1.04 Submittals

- A. Submit under provisions of Section 01 3300, Submittal Procedures.
- B. Shop Drawings: Indicate locations and mounting heights of each type of hardware, and material types.
- C. Submit manufacturer's parts lists, and templates to steel door and frame manufacturers for mortising of steel doors and frames. 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.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 Project Record Documents

- A. Submit under provisions of Section 01 7700, Closeout Procedures.
- B. Record actual locations of installed cylinders and their master key code.

1.06 Operation and Maintenance Data

- A. Submit under provisions of Section 01 7700, Closeout Procedures.
- B. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.07 Quality Assurance

- A. Perform work in accordance with the following requirements:
 - 1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
 - 2. NFPA 101.
 - 3. NFPA 80.
 - 4. NFPA 252.

1.08 Qualifications

- A. Manufacturer: 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.

1.09 Regulatory Requirements

- A. Conform to applicable code for requirements for fire rated doors and frames.

1.10 Delivery, Storage and Handling

- A. Deliver, store, protect and handle products to site under provisions of Section 01 6000.
- B. Upon request, the Contractor shall submit physical hardware as required, direct to door manufacturer's plant for installation. Such shipments shall be forwarded, prepaid.
- 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. Deliver keys for final cylinders to Owner by security shipment direct from hardware supplier.

1.11 Coordination

- A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

1.12 Warranty

- A. Provide 5-year warranty under provisions of Section 01 7700, Closeout Procedures.
- B. Warranty: Include coverage for door closers.

1.13 Maintenance Materials

- A. Provide maintenance materials under provisions of Section 01 7700, Closeout Procedures.

- B. Provide special wrenches and tools applicable to each different or special hardware component.
- C. Provide maintenance tools and accessories supplied by hardware component manufacturer.

Part 2 Products

2.01 Hardware for Metal Doors

- A. Description of Hardware Components:
 - 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 and operation of the door.
 - 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.
- B. Hinges:
 - 1. Stainless steel with ball bearings (steel hinges on fire rated doors), flat button tip, Stanley FBB 199 32D, Hager BB 1199, Ives A5111 or McKinney No. T4B3386.
 - 2. Hinges shall be 4-1/2" x 4-1/2" minimum 0.180 inches thick stainless steel with stainless steel pins.
 - 3. Interior doors shall have a minimum of 1-1/2 pair per leaf, (U.N.O.).
 - 4. Exterior doors shall have 2 pair, (U.N.O.).
 - 5. Exterior doors shall have non-removable pins (NRP).
- C. Mortise Locks:
 - 1. Corbin/Ruswin ML2000 series, Schlage L9000 series or Best 40H 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.
 - 2. Cylinder locks or unlocks outside lever. Inside lever always free for egress.
 - 3. 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.
 - 4. Provide all exterior doors with lock protector plates.
- D. Levers and Escutcheons:
 - 1. Levers shall be cast stainless steel; escutcheons shall be wrought stainless steel.
 - 2. Each lockset set shall be furnished complete with one pair of levers and escutcheons.

3. Model shall be Corbin/Russwin "ASP" – provide similar style for other Manufacturers.

E. Exit Devices:

1. US-26D smooth case with stainless steel touch bar and lever trim, mortised cylinder recess:
2. Base unit for rated and non-rated doors:
 - a. Von Duprin, No. 9875L x 996L break away lever design or
 - b. Precision Apex Series 2300 x V4908A
3. Provide matching Von Duprin 9827 Series or Apex 2200 Series, UL labeled device for fire rated double doors (provide vertical rod and bottom latch guards for this unit).
4. Interior doors do not require cylinders, unless noted in the hardware sets below.
5. Provide blank escutcheons for these locations; trim shall always be operable.
6. Strikes shall be stainless steel, dustproof; coordinate with exit devices, as required.
7. Provide tamperproof security type screws for installation.
8. Hardware for mechanical and electrical rooms shall have knurled levers.

F. Closers:

1. 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.
2. Closer arms shall allow for minimum 100-degree swing.
3. Closers shall be LCN 4000 Series, Ryobi D4550 or ENGINEER-approved equal, resistant to severe climatic conditions with a U.S.-26D sprayed finish on covers.
4. Provide SRI finish on closer bodies and arms.
5. Required accessories, brackets, plates, arms, spacers, etc, required for a complete installation shall be provided whether specifically called for or not.
6. Closers on exterior doors shall be mounted on the interior side of the door.

G. Kickplates:

1. Dull stainless steel (US32D), (.050) ga. 10-inch high except at doors with narrow bottom stiles where the height shall be reduced to ½-inch less than the height of the rail, and shall be 1-1/2-inch LDW on push side of single doors, 1-inch LDW on push side of pairs of doors.
2. Mount kickplates flush with lock style edge of pairs of doors.
3. Provide kickplates push side of all hollow metal doors.

H. Thresholds:

1. 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; finish shall be aluminum mill finish.
2. Provide one threshold for each exterior door opening.

I. Weatherstripping:

1. Durable Products, National Guard Products, Reese, Zero or Pemco.
2. Model No. listed are National Guard Products (NGP).
3. Head and jambs, NGP No. 160VA.
4. Vinyl; door bottom sweep, NGP 102VA.
5. Finish for weatherstripping shall be natural satin clear anodized aluminum.
6. Provide weatherstrip for all exterior doors.
7. Backpaint all surfaces in contact with dissimilar metals for protection prior to installation.

J. Door Stops:

1. Ives WS404CVX convex wall bumper with 626 satin chrome finish. All doors that contact the adjacent wall surface when they are in the full open position, shall receive a door stop.

K. Lock Protectors

1. Single exterior pedestrian doors shall be provided with lock protectors similar to Glynn Johnson LP series in stainless steel.
2. Coordinate exact model with door exit devices to insure proper clearances.

L. Substitutions: Under provisions of Section 01 6000 and in accordance with Section 01 2513.

2.02 Keying

- A. Locks shall be capable of accepting minimum six (6) pin cores and cylinders matching 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.
 3. 4 grand master keys.

2.03 Finishes

- A. Finishes: Satin chrome, U.S. 32D or 26D, when U.S. 32D is not available, unless otherwise noted in hardware product descriptions or schedule.
- B. All hardware screws, fasteners, etc. shall be Type 304 stainless steel.

Part 3 Execution

3.01 Examination

- A. Verify site conditions.
- B. 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. Use templates provided by hardware item manufacturer.
- C. Mounting heights for hardware from finished floor to center line of hardware item shall be per current State of Michigan, Barrier Free Code requirements.
- D. All thresholds shall be set in 2 continuous beads of sealant.

3.03 Field Quality Control

- A. Field inspection will be performed under provisions of Section 01 4500.
- B. Architectural Hardware
 - 1. Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.
 - 2. Contractor shall submit a letter from the Architectural Hardware Consultant certify the installation.

3.04 Adjusting

- A. Adjust work under provisions of Section 01 7700.
- B. Adjust hardware for smooth operation.

3.05 Protection of Finished Work

- A. Protect finished Work under provisions of Section 01 4500.
- B. Do not permit adjacent work to damage hardware or finish.

3.06 Schedule

- A. Set 1:
 - 1. Hinge – 1-1/2 Pair
 - 2. Closer
 - 3. Mortise Lockset – Passage Function
 - 4. Kickplate
- B. Set 2:
 - 1. Hinge – 2 Pair
 - 2. Closer H90
 - 3. Exit Device
 - 4. Mortise Locket – Entrance/Office Function
 - 5. Lock Protector

6. Kickplate
7. Weatherstripping
8. Threshold

End of Section

Section 08 9000 Louvers and Vents

Part 1 General

1.01 Scope of Work

- A. Provide louvers capable of withstanding the effects of wind and normal thermal movement without evidencing permanent deformation of blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.
- B. Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward or outward.
- C. Thermal Movements: Movements resulting from 120 degrees Fahrenheit (67 degrees Celsius) change (range) in ambient and 180 degrees Fahrenheit (100 degrees Celsius) change in surface temperatures.
- D. Maximum Standard Airflow Rating: Provide louvers with specified airflow at point of beginning water penetration through a louver 48 inches (1220 mm) wide by 48 inches (1220 mm) high (maximum standard airflow), as demonstrated by testing according to AMCA 500.

1.02 Submittals

- A. In addition to Product Data, submit the following:
 - 1. Shop Drawings: For louver units and accessories not completely described in Product Data.
 - 2. Samples of each type of metal finish.
 - 3. Product test reports indicating compliance of products with requirements.
 - 4. Manufacturers color charts showing the full range of colors, textures and patterns available.
- B. Field Measurements: Verify louver openings by field measurements before fabrication.

Part 2 Products

2.01 Manufacturers

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Airolite Co.
 - 2. All-Lite Louver Co.
 - 3. American Warming and Ventilating, Inc.
 - 4. Arrow United Industries.
 - 5. Construction Specialties, Inc.
 - 6. Greenheck Fan Corporation.
 - 7. Hart & Cooley, Inc.; Reliable Metal Products Division.
 - 8. NCA Manufacturing, Inc.

2.02 Materials

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy 3003 or 5005 with temper as required for forming.
- C. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel. Do not use metals that are incompatible with joined materials.
- D. Bituminous Paint: Asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or asphalt emulsion complying with ASTM D 1187.

2.03 Fabrication

- A. General: Fabricate louvers to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.
- B. Join frame members to one another and to fixed louver blades with fillet welds concealed from view.
- C. Join frame members to one another and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer.
- D. Fixed, Extruded-Aluminum, Horizontal Louvers: Provide louvers with extruded-aluminum frames and blades.
 - 1. Frame and Blade Thickness: 0.125 inch (3.18 mm).

2.04 Performance Requirements

- A. Drainable blade type with maximum standard airflow not less than 7500 cfm (3540 L/s) with not more than 0.18-inch wg (45-Pa) static-pressure loss.
- B. Descriptive Requirements: As follows:
 - 1. Blade Profile: Drainable blade.
 - 2. Blade Angle and Spacing: 45 degrees and 4 inches (100 mm) o.c. for 4-inch- (100-mm-) deep louvers.
- C. Louver Screens: Provide screens on interior faces of exterior louvers.
 - 1. Frames: Same kind and form of metal as indicated for louvers to which screens are attached.
 - 2. Louver Screening: As follows:
 - a. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

2.05 Finishes

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish louvers after assembly.

- B. Aluminum Finishes: Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 - 1. Class I, Color Anodic Finish: AA-M12C22A42/A44 complying with AAMA 606.1 or AAMA 608.1.
 - 2. Color: As selected by Architect from the full range of industry colors and color densities.

Part 3 Execution

3.01 General

- A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- E. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

End of Section

Division 09
Finishes

Section 09 1000

Piping Identification Systems

Part 1 General

1.01 Scope of Work

- A. CONTRACTOR shall furnish, mark, and install identification devices for exposed piping and piping in accessible chases and areas above ceilings with panels, and valves using color bands, lettering, flow direction arrows, and related permanent identification devices, and appurtenant works, in accordance with the requirements of the Contract Documents.

1.02 Related Work Specified Elsewhere

- A. Section 09 9000 Painting and Coatings
- B. Division 23: Heating, Ventilating, and Air-Conditioning
- C. Division 26: Electrical
- D. Division 40: Process Integration
- E. Division 41: Material Processing and Handling Equipment
- F. Division 42: Process Heating, Cooling, and Drying Equipment
- G. Division 43: Process Gas/Liquid Handling, Purification, & Storage Equipment
- H. Division 44: Pollution Control Equipment

1.03 Submittals

- A. In accordance with Section 01 3300, CONTRACTOR shall submit samples of all types of identification devices to be used in the work. CONTRACTOR shall also submit to ENGINEER, for approval, a list of suggested wording for all valve tags prior to fabrication.

Part 2 Products

2.01 Identification of Piping

- A. Exposed piping, piping in accessible chases, and piping in areas above ceilings with panels, shall be completely and totally painted for identification purposes.
 - 1. Piping shall be identified with lettering or tags designating the service of each piping system, shall have flow directional arrows, and shall be completely painted and color coded as scheduled below.
 - 2. Piping scheduled to be color coded shall be completely painted or coated with the indicated colors.
- B. Each pipe identification shall consist of 1) color coding in accordance with the Piping Identification Schedule; 2) a painted label; and 3) and a directional flow arrow. The painted label and directional arrow shall be placed between color bands. When more than one color band is used the different color bands shall be painted adjacent. Piping identification shall be located in accordance with Article 3.03 of this Section.
- C. Color Bands and Arrows:
 - 1. Pipe color bands shall be painted on the pipe. Paper or plastic banding of pipe shall not be acceptable.

2. Arrows shall be of the same color as the lettering and shall point away from the lettered labels in the direction of the flow.
3. Color band size shall be as follows:

Pipe Size (Outside Diameter)	Color Band Width
< 1"	1"
1" - 12"	1 pipe diameter
> 12"	12"

D. Lettering:

1. Contents identification labels shall be stenciled directly on pipes.
2. Black identification letters shall be used where the background pipe color is light, and white identification letters where the background color is dark.
3. The size of the letters for identification labels shall be as follows:

Pipe Size (Outside Diameter)	Letter Size
5/8" - 1"	5/16" high
1" - 3"	3/4" high
> 3"	2"

2.02 Existing Identification Systems

- A. In installations where existing piping identification systems have been established, CONTRACTOR shall continue to use the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the specified system. The objective is to fully identify all new piping, valves and appurtenances to the level specified herein.

2.03 Identification of Valves and Short Pipe Lengths

- A. Identifying devices for valves and the sections of pipe that are too short to be identified with color bands, lettered labels, and arrows shall be identified with metal tags as specified herein.
- B. Metal tags shall be of stainless steel with embossed lettering. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

2.04 Identification of Pipe 5/8 Inch or Smaller

- A. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, metal tags shall be provided instead of lettering.
- B. Tags shall have the specified identifying lettering stamped in the tag and shall be fastened to the pipe with suitable chains.
- C. Metal tags and chains shall be aluminum or stainless steel.
- D. Where tags are used, pipe shall be color coded as specified in Article 3.04 of this Section.

2.05 Miscellaneous

- A. Electrical conduit shall be painted to match ceiling or wall surfaces as directed by ENGINEER.
- B. Vent lines shall be painted to match the surfaces that they adjoin.
- C. Valve handwheels and levers shall be painted red.
- D. Hoist hooks and blocks shall be painted yellow with black stripes.

Part 3 Execution

3.01 General

- A. Labels and identification tags shall be installed in accordance with the manufacturer's printed instructions and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.

3.02 Valve Tags

- A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

3.03 Pipe Identification Location

- A. Straight lines of pipe shall be identified at intervals of 30 feet maximum, and at least once in each room unless otherwise directed by the Engineer.
- B. Piping shall also be identified at a point approximately within 2 feet of all turns, ells, valves, and on the upstream side of all distribution fittings or branches and on both sides of each floor, wall or barrier through which the line passes.
- C. For pipe runs of 50 feet or less the distance between bands shall be 30 inches. For pipe runs of 50 feet or more, spacing between bands shall be 72 inches.
- D. Sections of pipe that are too short to be identified with color bands, lettered labels, and directional arrows shall be tagged and identified similar to valves.

3.04 Identification Schedule

- A. Application of identifying devices shall conform to the following color codes, or match existing color code as directed by ENGINEER.

Type of Service	Pipe Color / Strip Color
<i>Domestic Water</i>	
Potable Water (RP Device)	Light Blue
Fresh Water (Air Gap)	Light Blue
<i>Industrial and/or Cooling Water</i>	
LPE	Dark Blue/Red
MPE	Dark Blue/Red
HPE	Dark Blue/Red
HPE (continuously chlorinated)	Dark Blue/Red/Yellow
Fire Water	Red
Industrial Water	Dark Blue

Type of Service	Pipe Color / Strip Color
Cooling Water Supply-Plant Effluent	Dark Blue/Red
Cooling Water Return-Plant Effluent	Dark Blue/Red
Cooling Water Return-Industrial Water	Dark Blue
Cooling Water Supply-Industrial Water	Dark Blue
Reclaimed Water	Purple
Final Effluent	Dark Blue/Red
Irrigation (continuously chlorinated eff.)	Dark Blue/Red/Yellow
<i>Chemical Supply Lines (Extremely Dangerous)</i>	
Chlorine (gas or liquid)	Yellow
Chlorine Solution	Yellow
Sodium Hydroxide	Yellow
Chlorinator Vent and Detection Lines	Yellow
Hydrazine	Yellow
Lime Slurry	Yellow
Sodium Hypochlorite	Yellow
Ferric Chloride	Yellow
Ferrous Chloride	Yellow
Phosphoric Acid	Yellow
Concentrated Sulfuric Acid	Yellow
Dilute Sulfuric Acid	Yellow
Chemical Draw and Vent	same color as the chemical line
Dilute Acid	Yellow
<i>Chemical Supply Lines</i>	
Anionic Polymer	White/Yellow
Cationic Polymer	White/Yellow
Nonionic Polymer	White/Yellow
Chemical Draw and Vent	same color as the chemical line
Sulfite/Bisulfite Scrubbing Liquid	White/Yellow
Stratford Solution (Scrubbing Liquor)	White/Yellow
<i>Sludge/Ash Transport and Process Lines</i>	
Blended Sludge	Dark Brown
Bottom Sludge	Dark Brown
Centrate (from digested sludge dewatering)	Dark Brown/Dark Blue
Centrate (H ₂ S Scrubbing)	White/Yellow
Circulated Sludge	Dark Brown
Digested Sludge	Dark Brown
Sulfur Slurry (H ₂ S Scrubber)	Dark Brown
<i>Sludge/Ash Transport and Process Lines</i>	
Sludge Filtrate Dark	Brown/Dark Blue
Raw Sludge	Dark Brown
Screened Digested Sludge	Dark Brown
Waste Activated Sludge	Light Brown
Digester Cleanings	Dark Brown
Digested Sludge to Screenings	Dark Brown

Type of Service	Pipe Color / Strip Color
Digested Sludge to Blending Tanks	Dark Brown
Digested Sludge Recirculated/Transfer	Dark Brown
Digested Sludge Withdrawal	Dark Brown
Thickened Waste Activated Sludge	Light Brown
Return Activated Sludge	Light Brown
Thickener Subnatant Light	Brown/Dark Blue
Thickener Subnatant Overflow	Light Brown/Dark Blue
Cyclone Effluent	Dark Brown/Dark Blue
Grit	Dark Brown
Mixed Liquor	Light Brown
Thickener Pressurized Recycle	Light Brown/Dark Blue
Scum	Dark Brown
Ash (hydraulic)	Light Brown
Processed Condensate	Dark Blue/Light Brown
Process Effluent	Dark Blue/Red
Final Clarifier Influent	Light Brown
<i>Pneumatic Transport Lines</i>	
Sludge Derived Fuel	Light Green/Orange
Hot Ash	Light Green/Yellow
Sand Transport	Light Green
<i>Air and Vacuum Supply Lines</i>	
Oxygen (gaseous)	Purple/Black
Oxygen (liquid)	Purple/Black
Combustion Air	Green
Compressed Air (non-instrument)	Green/Red
<i>Air and Vacuum Supply Lines</i>	
Instrument Air	Green/White
Process Air	Green
Product Air	Green/Light Green
Foul Air	Green/Grey
Nitrogen (liquid)	Green/Black
Nitrogen (gaseous)	Green/Black
Vacuum	Green
Vent Duct	same as line color
<i>Boiler Waters</i>	
Boiler Feedwater Makeup	Dark Blue/Orange
Boiler Feedwater	Dark Blue/Orange
Continuous Blow-down	Dark Blue/Orange
Demineralized Water	Dark Blue/Orange
H. P. Condensate	Dark Blue/Orange
L. P. Condensate	Dark Blue/Orange
M. P. Condensate	Dark Blue/Orange
Intermittent Blow-down	Dark Blue/Orange
Softened Water Dark	Blue/Yellow

Type of Service	Pipe Color / Strip Color
Reverse Osmosis Treated Water (permeate)	Dark Blue/Orange
Steam	
Low-pressure Steam	Orange/Red
Medium-pressure Steam	Orange/Red
High-pressure Steam	Orange/Red
Lube and Hydraulic Oils	
Hydraulic Oil Supply	White/Orange
Hydraulic Oil Return	White/Orange
Lube Oil	White/Orange
Drain Oil	White/Orange
Oil Vapor	White/Orange
Grease	White/Orange
Defoamant-Sludge Blending Tanks (Kerosene)	White/Orange
Fuel Supply	
Natural Gas/LNG/Propane	Orange
Digester Gas: LP, MP, and HP	Orange
Diesel	Orange
Laboratory	
Distilled Water	Dark Blue/Orange
Miscellaneous	
Equipment Vent	same as equipment
Sample Line	same as line or equipment being sampled
Spare Chemical	same as chemical
Sanitary Sewer/Storm Drains	
Roof Drain	Black or same color as bldg walls
Plant Drain	Black
Storm Drain	Black
Sump Pump Discharge	Black
Sanitary Sewer	Black
Sanitary Vent	Black
Influent Raw Sewage (up to primary tanks)	Grey
Demineralized Waste	Black/Yellow
Reverse Osmosis Reject	Black

End of Section

Section 09 9000 Painting and Coatings

Part 1 General

1.01 Section Includes

- A. Surface preparation and field application of paints and coatings.
- B. New surfaces and construction shall be painted. Existing surfaces and areas shall be painted as called for on the Drawings.

1.02 Related Sections

- A. Section 04 2200: Concrete Masonry and Grout

1.03 References

- A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. AWWA (American Water Works Association) - D102 - Painting Steel Water Storage Tanks.
- C. International Concrete Repair Institute (ICRI) Guideline No. 310.2-1997 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- D. NACE (NACE International) -Industrial Maintenance Painting.
- E. SSPC (SSPC: The Society for Protective Coatings) SSPC Painting Manual Volumes 1 and 2.

1.04 Definitions

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.05 Submittals

- A. Submit under provisions of Section 01 3300.
- B. Product Data: Provide data on all products and special coatings. Data shall include manufacturer's suggested surface preparation and coating thicknesses.
- C. Samples: Submit two samples, 1-inch x 3-inch (25 x 76 mm) in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention, environmental considerations and any restrictions regarding time recoat.

1.01 Qualifications

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section and one of the four companies listed.
- B. Applicator: Company specializing in performing the work of this section with minimum three years', approved by manufacturer.

1.02 Delivery, Storage and Handling

- A. Deliver, store, protect and handle products to site under provisions of Section 01 6000.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Only materials approved for use on this project shall be delivered to the site.
- E. Store paint materials at minimum ambient temperature of 45 degrees Fahrenheit (7 degrees Celsius) and a maximum of 90 degrees Fahrenheit (32 degrees Celsius), in ventilated area, and as required by manufacturer's instructions.
 - 1. Any material found on the project that is stored in areas that are outside of the above temperature requirements shall not be used on the project and shall immediately be removed from the site.

1.03 Environmental Requirements

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the coating product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints:
 - 1. Minimum application temperatures shall be as required by the coating manufacturer's instructions.
 - 2. If there are no explicit printed recommendations by the manufacturer, minimum temperature of the air and surface to be painted shall be 50° Fahrenheit.
- D. Provide lighting level of 80-foot candles (860 lx) measured mid-height at substrate surface during coating operations in the area being painted.

1.04 Surfaces Not Requiring Painting

- A. Aluminum.
- B. Stainless Steel.
- C. FRP Doors and Frames.
- D. PVC and Fiberglass Pipe and Ductwork.
- E. Inside of pipe spaces, duct shafts, and similar areas not exposed to view.
- F. Exterior galvanized grating or checkered plate need not be painted, except to meet MIOSHA requirements.

1.06 Existing Painted Surfaces

- A. Existing painted surfaces that will be affected by project activities are to be tested by CONTRACTOR as part of this Work scope to determine if they contain lead. Any lead-based paint at affected areas are to be removed and abated in accordance with all federal, state and local regulations and guidelines as part of this work scope. Provide documentation of compliance methods to OWNER for record as part of submittals.

Part 2 Products**2.01 Manufacturers**

- A. Manufacturers - Paint and Special Coatings
 - 1. Tnemec Company
 - 2. Carboline Company
 - 3. Sherwin-Williams Company
 - 4. PPG/Amercoat
- B. Substitutions: No substitutions are allowed.
- C. Products used on this project shall be from the same manufacturer unless written authorization is received from ENGINEER.

2.02 Materials

- A. Coatings:
 - 1. Ready mixed, except field catalyzed coatings.
 - 2. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials:
 - 1. As recommended by the manufacturer and required to achieve the finishes specified, of commercial quality.
- C. Patching Materials:
 - 1. Latex filler.

2.03 Finishes

- A. Refer to schedule at end of section for surface finish schedule.
- B. Colors will be selected by OWNER from color samples submitted.

Part 3 Execution**3.01 Examination**

- A. Verify site conditions under provisions of the General Conditions.
- B. Verify that surfaces and/or substrate conditions are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

- D. Commencement of the coating operations will signify acceptance of the substrate(s) as being suitable for the coating and ability to achieve the final results specified.
- E. Test shop applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 2. Concrete Floors: 8 percent. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.

3.02 Preparation

- A. Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Correct defects and clean surfaces which affect work of this section.
 - 1. Remove existing coatings that exhibit loose surface defects.
- C. Marks:
 - 1. Seal with a stain-blocking primer marks which may bleed through surface finishes.
- D. Impervious Surfaces:
 - 1. Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach.
 - 2. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces shall be backcoated with OWNER approved epoxy/sealer (Tnemec Series N69 or Carboline Rustbond penetrating sealer; or Sherwin-Williams Macropoxy 646 or Amerlock sealer) prior to installation to provide separation of dissimilar materials.
 - 1. CONTRACTOR shall note that all dissimilar materials shall be kept from direct contact by the use of approved insulating and isolating materials.
 - 2. Surfaces shall be clean and if necessary, treated with Clean'n Etch, Great Lakes Laboratories – Livonia, Michigan.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish:
 - 1. Remove foreign particles to permit adhesion of finishing materials.
 - 2. Apply compatible sealer or primer.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Fiberglass and PVC piping and connected items as shown on the drawings shall remain unpainted.
 - 1. However, stenciled painted arrows, color bands, etc. shall be provided to agree with OWNER's Standard Color Code.
 - 2. Surface shall be lightly sanded below code markings prior to painting to obtain a roughened surface.

3. Surface shall then be wiped with approved thinner solution.
4. Markings shall then be applied as soon as the thinner has dried.

I. Galvanized Surfaces Priming:

1. Galvanized surfaces scheduled for painting shall not be water quenched at the end of the galvanizing process.
2. Remove gloss from the new spangled galvanizing by sweep blasting in accordance with the SSPC, SP-15.
 - a. Non-abrasive organic blasting media shall be utilized.
 - b. Environmental conditions shall be maximum 50% relative humidity and minimum piece and room temperature of 70 degrees F.
3. An alternate cleaning method of phosphating may be utilized if a detailed procedure is submitted for approval prior to the start of work.
4. Cleaned surfaces shall not remain overnight without a prime coat.
5. Galvanize metal primer shall be Tnemec, Tneme-Zinc 90G, Carboline, Carbozinc 859 Primer, Sherwin-Williams DTM Wash Primer or Amercoat 68MCZ.

J. Galvanized Surface Repair:

1. Damaged or welded galvanized areas shall have the galvanizing repaired in accordance with the current edition of ASTM A780.
 - a. Areas shall be repaired utilizing paints containing zinc dust.
 - b. Paint shall be stirred periodically in accordance with the manufacturer's recommendations to maintain the zinc in suspension.
 - c. The repair areas shall be painted with a brush, spray painting will not be allowed.
2. Abraded galvanized areas shall be spot primed with a cold galvanizing compound, Tnemec 90-97 Tneme-Zinc, Carbozinc 11 HSN Carboline, Sherwin-Williams Zinc Clad 5 (aerosol), Amercoat 68MCZ or ZRC product with 95% pure zinc dust.
3. Spot prime all abraded galvanized areas not primed by other trades, to present a complete, protected area, to receive finish coats.

K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish:

1. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.
2. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry.
3. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
4. Allow to dry.
5. Application of block filler will be by roller or brush.

6. Spraying will not be allowed.
- L. Uncoated Steel and Iron Surfaces:
1. Remove grease, dirt, and other visible contaminants by washing with solvent (SSPC-SP-1)
 2. Where mill scale, weld spatter, and rust are evident, remove by power tool wire brushing (SSPC-SP-3) or where required, abrasive blast cleaning (SSPC-SP-10 or SSPC-SP-6);
 3. Spot prime paint after repairs.
 4. Actual surface preparation procedure shall be based on approved coating manufacturer's published recommendations.
- M. Shop Primed Steel Surfaces:
1. Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous.
 2. Clean surfaces with solvent.
 3. Prime bare steel surfaces.
 4. Prime metal items including shop primed items.
- N. Mechanical Equipment components to be field painted are to be pre-coated on site prior to assembly.

3.03 Application

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Vacuum clean surfaces free of loose particles and/or use tack cloth just prior to applying next coat.
- F. Allow applied coat to dry before next coat is applied.
- G. Insulated pipe, fittings and equipment without an approved surface material or color shall be painted with 2 coats of Tnemec Series 115 Uni-Bond DF, Carboline Carbocrylic 3359, Sherwin-Williams DTM Acyclic or PPG Pitt-Tech DTM Enamel 90-374 Series which complies with the Color Code prescribed herein.
- H. Material labels and accompanying direction of flow arrows shall be applied to all distribution mains on maximum spacing of 50 feet.
 1. They shall be placed at those points on all main lines where branch mains are extended therefrom, and on the distribution mains at both sides of all solid building partitions.

2. Material labels and flow arrows shall be custom made for all piping systems governed by this contract, signifying the kind of material to be conducted and its direction of flow.
 3. Labels shall be self-adhesive and suitably coated to make them waterproof, and impervious to dirt.
 4. These labels shall have the identifying names superimposed on OWNER's approved background color in full or abbreviated, to meet OWNER's requirements and print the width of the label.
- I. Where letters and arrows cannot be applied to pipe lines, they shall be applied to metal panels, and in a manner to agree with identification listed in the Color Code.
1. Panels shall be 18 gage painted steel and hung on pipes every 50', near branch line connections and on either side of solid building partitions that pipes pass thru.
 2. On lines where there is flow in both directions, double arrows shall be used.
 3. On pipes where there is flow in one direction, single arrows shall be used.
- J. Substation equipment, control panels, panel boards, and other equipment specified to receive factory finish shall not be painted.
1. However, factory painted equipment which is chipped or defaced due to handling, installation or construction activities shall be refinished in a manner satisfactory to OWNER.
 2. This shall include glazing, sanding, and refinishing entire surface to a suitable boundary to avoid a patched effect.
 3. Suitable boundaries shall be changes in planes of surfaces such as corners, frames, mouldings, recesses, etc.
- K. Hazardous areas, moving machinery, handrails, and all other similar areas shall be finished to agree with OWNER's Standard Safety Code and all MIOSHA requirements, as approved by OWNER.

3.04 Finishing Mechanical and Electrical Equipment

- A. Refer to Division 26 Electrical for information on electrical identification requirements.
1. Refer to the end of this Section for color coding and identification banding of equipment, duct work, and piping.
- B. Paint shop primed equipment.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports.
- E. Paint dampers exposed behind louvers, grilles, to match face panels.
- F. Paint exposed conduit and electrical equipment occurring in painted areas.

- G. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- H. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated.
 - 1. Color band and identify with flow arrows and names, to match the existing installation.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 Field Quality Control

- A. CONTRACTOR shall refer to the SSPC Paint Inspection: Daily Coating Inspection Report that is a part of this section of the Specifications
 - 1. This report shall be filled out daily for every day that the painter is on site and working.
 - 2. The reports shall be filled out in their entirety as applicable for the work being performed.
 - 3. Provide multiple reports if necessary because the work for the day will include several coatings so each paint/coating type is properly documented.
 - 4. Reports shall be available to OWNER and OWNER's representative upon request at the site.
 - 5. Copies of these daily reports shall be submitted with each Payment Application for painting and coating work performed on this project for the period that is covered by the Payment Application.
 - 6. Failure to submit reports or deficient reports shall be reason to not approve the requested payment for the work.
- B. Field inspection and testing will be performed under provisions of Section 01 4500.
- C. Areas will be tested at random with dry film thickness gage.
 - 1. Any areas not meeting the minimum dry film thickness shown in the schedule or on approved Shop Drawing submittals shall have additional coats applied so the minimum dry film thickness is achieved.
 - 2. Each coat shall achieve the minimum dry film thickness specified, without regards to the overall system thickness.
- D. If an existing surface or area is not called out for painting but is defaced or damaged due to new Work under this Contract, then this surface or area shall be repainted to match adjacent areas, at no additional cost to OWNER.
 - 1. Repair areas shall be to a suitable area boundary as determined by ENGINEER in the field.
 - 2. A repaired area may include an entire wall or the entire floor in a room or gallery.
 - 3. Patched effect repairs shall not be acceptable.

3.06 Cleaning

- A. Clean work under provisions of Section 01 7700.
- B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
- C. Make good all damage done to floors and other work through neglect or carelessness or from failure to properly protect work from damage resulting from the execution of this work.

3.07 Schedule - Interior and Exterior Surfaces

Paint System	Surfaces
1	Exterior Ferrous Metals.
2	Ferrous Metals, Piping and Equipment Located Indoors (not specified elsewhere).
3	Interior Masonry units.

- A. CONTRACTOR shall note that PVC/fiberglass designation painting in addition to lightly sanding and wipe off with approved thinner solution shall consist of two coats of finish specified under Painting System No. 2 for the area to receive the identification.
- B. Painted walls, without applied base, shall be scribed 4" and painted with a 4" high, gloss black base.
 - 1. Material for base shall be compatible with the wall material.
- C. Aluminum Surfaces shall be back-coated with an OWNER approved epoxy/sealer. Refer to paragraph 3.2.E of this Section.

3.08 Painting - Systems

- A. Painting System No. 1 - Exterior Ferrous Metals Surface Preparation - SSPC-SP 6.

See Next Page for Painting System No. 1

Layer	Min. No. of Coats per Coating Layer	Product Name	Min. Total Thickness of Coating Layer Dry	Type
Primer	1	Tnemec Series N69	3.0	Polyamide Epoxy
Intermediate	1	Tnemec Series N69	4.0	Polyamide Epoxy
Finish	1	Tnemec 1075 Endura Shield	3.0	Aliphatic/ Acrylic Polyurethane
Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
Intermediate	1	Carboline 890	4.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline 134 HG	3.0	Aliphatic/Polyurethane
Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Intermediate	1	Sherwin-Williams Macropoxy 646	4.0	Epoxy
Finish	1	Sherwin-Williams Acrolon 218 Or Hi-Solids Polyurethane	3.0	Aliphatic/Polyurethane
Primer	1	PPG Amerlock 2/400	4.0	Polyamide Epoxy
Intermediate	1	PPG Amerlock 2/400	4.0	Polyamide Epoxy Aliphatic
Finish	1	PPG Amerlock 2/400	4.0	Polyurethane
CONTRACTOR shall choose one of Primer-Intermediate-Finish systems listed above. Total Thickness of System – 10.0/12.0 Dry Mills Min. CONTRACTOR shall note curing times required between coats, per actual product used.				

- B. Painting System No. 2 – Interior Ferrous Metals, Piping and Equipment Located Indoors
Surface Preparation - SSPC-SP 6.

See Next Page for Painting System No. 2

Layer	Min. No. of Coats per Coating Layer	Product Name	Min. Total Thickness of Coating Layer Dry	Type
Primer	1	Tnemec Series N69 Epoxoline	3.0	Epoxy
Finish	2	Tnemec Series N69 Epoxoline	8.0	Epoxy
Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
Finish	2	Carboline 890	8.0	Cycloaliphatic Amine Epoxy
Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Finish	2	Sherwin-Williams	8.0	Epoxy
Primer	1	PPG Amerlock 2/400	4.0	Polyamide Epoxy
Finish	2	PPG Amerlock 2/400	7.0	Polyamide Epoxy
CONTRACTOR shall choose one of Primer-Finish systems listed above. Total Thickness of System – 11.0 Dry Mils Min.				

C. Painting System No. 3 - Interior Masonry units Surface Preparation - SSPC-SP 13/NACE 6.

Layer	Min. No. of Coats per Coating Layer	Product Name	Min. Total Thickness of Coating Layer Dry	Type
Undercoat	1	Tnemec 130-6602 Envirofill	60-80 s.f. gal.	Waterborne Cementitious Acrylic
Primer	1	Tnemec Series N69 Hi-Build Epoxoline II	4.0	Epoxy
Finish	1	Tnemec Series N69 Hi-Build Epoxoline II	4.0	Epoxy
Undercoat	1	Carboline Sanitile 500 Block Filler	60-100 s.f. gal.	Water Based Epoxy Filler
Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline 890	3.0	Cycloaliphatic Polyurethane
Undercoat	1	Sherwin-Williams Cement-Plex 875	60-100 s.f. gal.	Cementitious Waterborne Block filler
Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Finish	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Primer	1	PPG Amerlock 400BF	60-100 s.f.	Epoxy Masonry Block Filler
Intermediate	1	PPG Amerlock 2/400	4.0	Polyamide Epoxy
Finish	1	PPG Amerlock 2/400	4.0	Polyamide Epoxy
CONTRACTOR shall choose one of Undercoat-Primer-Finish/ Primer-Intermediate-Finish systems listed above. Total Thickness of System – 6.0/8.0 Dry Mils Minimum over filled surface.				

3.09 Schedule - Equipment Colors

Equipment	Color
Blowers	*
Compressors	*
Couplings	Yellow
Cranes (Hoists)	Yellow
Blocks	Yellow and Capacity in Black
Fans	Orange
Flow Meters	*
Gear Reducers	Yellow
Guards	Orange
Motors	Orange
Equipment	Color
Pumps	*
Screens	*
Switch Enclosure	Orange
Tanks	*
Valves	*
Valve Operators	Yellow
Handrail/Guardrail	Orange **
Handrail/Guardrail-Removable	Yellow & Black **
Fire Protection Equipment	Red
Emergency Stop Bars, Buttons, Etc.	Red
First Aid Kits and Enclosures- containing First Aid Equipment	Green
Safety Showers, Face Washes, etc. (Area Around)	Green
Transformers	Orange
Switchgear	Grey or Buff
Misc. Metal	Black (unless otherwise noted)
* Color will depend on service. The color will be obtained from the "PIPE COLOR CODE" for the service. (No stripes used on equipment.)	
** Brass, aluminum or stainless steel need NOT be painted.	

- A. The following colors shall be in conformity with the current ANSI Z553.1-2006 as referred to by MIOSHA:

1. Red
2. Orange
3. Yellow
4. Green
5. Blue
6. Purple
7. Black
8. White

- B. Colors shall meet the tests specified in Section 3, Color Definitions, of the current ANSI/NEMA Z535.1-2006

3.10 Schedule - Piping Colors

Service	Color	Stripe
Potable Water - Cold	Green	
Potable Water - Hot	Green	Aluminum (1)
Emergency Shower Water	Green	Yellow (1)
Flushing Water	Gray	Blue (1)
Decant Water	Gray	White (1)
Industrial Water	Blue	
Ground Water	Blue	Green (1)
Instrument Air	Purple	Blue (1)
Natural Gas	Yellow	
Vacuum	Purple	Aluminum (1)
Roof Conductors	Match Background	
Floor Drains	Match Background	
Sump Pump Discharge	Gray	Black (1)
Sanitary Drains & Vents	Black	
Raw Sewage or Wastewater	Gray	
Sample Lines	Match System Being Sampled	
Service	Color	Stripe
Electrical Conduit	Match Background	
Stainless Steel		6" band with 3/4" stripes at 1"
Copper		6" band with 3/4" stripes at 1"
Plastic		6" band with 3/4" stripes at 1"

See Sample Daily Coating Inspection Form on Next Page

Paint Inspection: Daily Coating Inspection Report

Date: / / M T W Th F S Su		Pg. Of	
Project #:		COPY To:	
Inspector:		☐ GC Mgr ☐ Owner ☐ Contr ☐ _____	
Project/Client:		Attachments:	
Location:		☐ DFT Sheet ☐ NCR/CAR ☐ _____	
Description:			
Requirements:			
Contractor:		Spec # Revision #	
Description of Areas & Work Performed		Hold Point Inspections Performed	
		☐ 1 Pre Surface Prep/Condition & Cleanliness ☐ 2 Surface Preparation Monitoring ☐ 3 Post Surface Preparation/Cleanliness & Profile ☐ 4 Pre Application Prep/Surface Cleanliness ☐ 5 Application Monitoring/Wet Film Thickness (WFT) ☐ 6 Post Application/Application Defects ☐ 7 Post Cure/Dry Film Thickness (DFT) ☐ 8 Nonconformance/Corrective Actions Follow-up ☐ 9 Final Inspection	
		Approved By: _____	
Surface Conditions		Ambient Conditions	
☐ New ☐ Maint ☐ Primer/Paint ☐ Age/Dry/Cure _____ ☐ Steel ☐ Galvanize ☐ Concrete ☐ Other _____ ☐ Hazard _____ ☐ Sample Report # _____ ☐ Degree of contamination: _____ Test: ☐ Cl _____ $\mu\text{g}/\text{cm}^2$ / ppm ☐ Fe _____ ppm ☐ pH _____ ☐ Degree of Corrosion: _____ ☐ Scale ☐ Pitting/Holes ☐ Crevices ☐ Sharp Edges ☐ Weld _____ ☐ Moisture ☐ Oils ☐ Other _____ ☐ Painted Surface Condition: _____ Dry to: ☐ Touch ☐ Handle ☐ Recoat ☐ Dry/Over Spray ☐ Runs/Sags ☐ Pinholes ☐ Holidays ☐ Abrasion ☐ Fall Out ☐ Other _____		Time (Indicate AM or PM) : : : : Dry Bulb Temp ⁰ (C/F) : : : : Wet Bulb Temp ⁰ (C/F) : : : : % Relative Humidity % % % % Surface Temp ⁰ (C/F) Min/Max / / / / Dew Point Temp ⁰ (C/F) : : : : Wind Direction/Speed : : : : Weather Conditions: : : : :	
Surface Preparation		Application	
Start Time: _____ Finish Time: _____ Est Sq/ft: _____ ☐ Solvent Clean ☐ Hand Tool ☐ Power Tool ☐ HP Wash PSI _____ ☐ Other _____ ☐ Abrasive Blast ☐ Abrasive Type _____ ☐ Sample ☐ Blast Hose Size _____ ☐ Nozzle Size / PSI _____ ☐ Air Supply CFM _____ ☐ Air Supply Cleanliness ☐ Water/Oil Trap Check ☐ Equipment Condition Check		Start Time : Finish Time : Est. Sq/ft. ☐ Primer ☐ Intermediate ☐ Topcoat ☐ Touch-up Generic Type: _____ Qty Mixed: _____ Manuf.: _____ Mix Ratio: _____ Prod Name: _____ Mix Method: _____ Prod #: _____ Strain/Screen: _____ Color: _____ Material Temp: _____ ⁰ F Kit Sz/Cond.: _____ Sweat-in Time: _____ Min/Hrs Shelf Life: _____ Pot Life: _____ Min/Hrs	
Surface Cleanliness & Profile Measurement		Batch #'s	
☐ Job Specification ☐ SSPC/NACE - SP- _____ ☐ SSPC/NACE Spec / Visual Stds ☐ _____ Profile Check: _____ ☐ Disc ☐ Tape ☐ Gauge ☐ Specified _____ mils avg. / Achieved _____ mils ☐ Surface effect on DFT Gauge/BMR _____ mils		Reducer #: _____ Qty Added: _____ Pt/Gal % by Vol: _____ % Specified WFT Avg: _____ Mils Achieved WFT Avg: _____ Mils ☐ Airless/Conv. Spray ☐ Brush ☐ Roller ☐ Other _____ Pump Pot _____ Hose Dia. _____ Air Check _____ Ratio/Size _____ Hose Lng. _____ SEP/Trap _____ GPM/CFM _____ Spray Gun _____ Filter _____ PSI _____ Tip Sz. _____ Agitator _____	
Dry Film Thickness			
Gage Type / Model	Gage Serial #	Gage Calib. Verified	Spec Avg. DFT
			Total Avg DFT
			DFT Last Coat
			DFT This Coat
		Inspector's Signature _____ Date _____	

End of Section

Division 10
Specialties

Section 10 1400 Signs

Part 1 General

1.01 Section Includes

- A. Metal, painted safety signage.
- B. Miscellaneous mounting hardware and anchors.

1.02 Submittals

- A. Submit under provisions of Section 01 3300.
- B. Submit shop drawings listing sign styles, lettering and locations, and overall dimensions of each sign.
- C. Submit full size drawing of plaque indicating actual text size, spacing, and width.
- D. Submit samples under provisions of Section 01 3300.
- E. Submit two samples illustrating full size sample sign, of type, style and color specified including method of attachment.
- F. Submit manufacturer's installation instructions under provisions of Section 01 3300.
- G. Include installation template and hardware.

1.03 Delivery, Storage, And Handling

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 6000.
- B. Package signs, labeled in name groups.
- C. Store adhesive tape at ambient room temperatures.

1.04 Environmental Requirements

- A. Do not install adhesive tape mounted signs when ambient temperature is below 70 degrees F (21 degrees C). Maintain this minimum during and after installation of signs for adhesive to cure.

Part 2 Products

2.01 Manufacturers

- A. Safety Signage:
 - 1. Stonehouse
 - 2. Seton Name Plate Company
 - 3. Brady, USA, Inc.
- B. Substitutions: Under provisions of Section 01 6000.

2.02 LETTERING

- A. Safety Signage:
 - 1. Per MIOSHA requirements.
 - 2. Colors: As noted in schedule.

2.03 ACCESSORIES

- A. Safety Signage: Non-corrosive, stainless steel, theft-proof mounting screws and anchors for required for substrate.

Part 3 Execution

3.01 Examination

- A. Provide signage for each of the rooms or areas identified in the Signage Schedule.
- B. Provide safety signage as indicated in the Signage Schedule.
- C. Verify that surfaces are ready to receive work.
- D. Beginning of installation means installer accepts existing surfaces.

3.02 Installation

- A. Install in accordance with manufacturer's instructions and current State of Michigan Barrier Free requirements.
- B. Install signs after surfaces are finished, in locations adjacent to the doors (or adjacent to accessories for safety signage), at the required heights to meet current State of Michigan Barrier Free, and applicable NFPA, MIOSHA requirements.
- C. Use fasteners appropriate for the substrate.
- D. Locate sign on wall surface, level.
- E. Clean and polish.

3.03 Signage Schedule

UNSAFE WATER SIGN

The Contractor shall furnish and install a sign reading "CAUTION-Unsafe Water - Do Not Drink" at all industrial water outlet locations. The sign shall be a minimum of 10" wide and 8" high with letters a minimum 1" high. The sign shall be of weatherproof construction, permanently affixed to the building structure. The word "CAUTION" shall be yellow on a black background in the upper panel. The lower panel where additional wording is, shall be black letters on a yellow background.

POLYMER FILL STATION SIGN

The Contractor shall furnish and install a sign reading "CAUTION – Polymer Fill Point – Polymer Only, Contact Owner at XXX-XXX-XXX Prior to Access" at exterior side of polymer fill box. The sign shall be a minimum of 10" wide and 10" high with letters a minimum 1" high. The sign shall be of weatherproof construction, permanently affixed to the housing. The word "CAUTION" shall be yellow on a black background in the upper panel. The lower panel where additional wording is, shall be black letters on a yellow background. Verify exact phone number to be inscribed in place of placeholder XXX-XXX-XXXX on sign with OWNER.

END OF SECTION

Division 22
Plumbing

Section 22 1316

Waste and Vent Systems

Part 1 General

1.01 Scope of Work

- A. Section includes building sanitary and vent piping systems, including drains and drainage specialties.

1.02 Definitions

- A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.03 Submittals

- A. Shop Drawings and Product Data shall be submitted in accordance with Section 01 3300 Submittal Procedures.
- B. Shop Drawings covering the items included under this Section for the following products:
 - 1. Drainage piping specialties.
 - 2. Floor drains.

1.04 Reference Standards

- 1. Michigan Plumbing Code.
- 2. Michigan Mechanical Code.

1.05 Sequencing and Scheduling

- A. Coordinate the installation of vents, flashing, roof penetrations, and flashing materials with installation of roofing, waterproofing, and adjoining substrate work.
- B. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

- C. Coordinate the installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.

Part 2 Products

2.01 Manufacturers

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
1. Drainage Piping Specialties, including backwater valves, expansion joints, drains, trap primers, and vandal-proof vent caps:
 - a. Josam Manufacturing Co.
 - b. Smith (Jay R) Manufacturing Co.
 - c. Tyler Pipe; Subs. of Tyler Corp.
 - d. Wade
 - e. Zurn Industries, Inc; Hydromechanics Division.
 2. Freeze-proof vent caps:
 - a. F.J. Moore Manufacturing Co.

2.02 Materials

- A. Unless otherwise noted, pipe materials shall conform to the following:

Item	Spec. No.	Remarks
Sanitary waste and storm piping	62.2	D.I.
Sump pump discharge (interior)	64.6	PVC
Sump pump discharge (buried)	64.7	HDPE

2.03 Drainage Piping Specialties

- A. Expansion Joints: Ductile iron body with adjustable bronze sleeve; bronze bolts with wing nuts.
- B. Floor Cleanouts: Furnish and install cleanouts where indicated on Drawings at all bends, angles, upper terminals, and not over 50 feet apart. All cleanouts shall have bronze countersunk rectangular slotted plugs lubricated with nonhardening thread lubricant and flush-with-floor, heavy-duty ductile iron cleanout tops with nonskid covers. Flashing flange is required on membrane floors. Provide extra heavy nickel bronze tops in tiled floor areas.
- C. Flashing Flanges: Cast iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.
- D. Vent Flashing Sleeves: Cast iron caulking type roof coupling for cast iron stacks, cast iron threaded type roof coupling for steel stacks, and cast bronze stack flashing sleeve for copper tubing.

2.04 Floor Drains

- A. Provide ductile iron, round floor drains having a minimum of 30 square inch free grate area. Provide with double drainage flange. Rectangular floor drains shall have a minimum of 14 square inches free grate area. Connections shall be screwed, hub or inside caulked as required by the particular location. All sanitary system floor drains shall be trapped.
- B. Equipment drains shall consist of a trapped pipe hub outlet located approximately 2 inches above finished floor.

Part 3 Execution

3.01 Examination

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- D. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 Preparation Foundation for Underground Building Drains

- A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.
- C. Shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.03 Installation

- A. Drainage connections shall be provided from the floor drainage system to the equipment as shown on Drawings. Reducing couplings shall be used to fit the equipment outlets provided. All future equipment outlets shall be provided with a plug.
- B. No exposed drainage pipe, for any purpose, shall be less than 1-1/2 inches in diameter, and ground-buried less than 3 inches in diameter. The ends of all runs and the bases of all stacks shall be provided with cleanout extensions stopped with brass plugs. All drainage lines shall be properly trapped and be adequately pitched toward the outlet.
- C. Drainage systems under foundation footings shall be encased in concrete.

- D. Make changes in direction for drainage and vent piping using appropriate 45-degree wyes, half-plies, or long sweep quarter, 6th, 8th, or 16th bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- E. Install underground building drains to conform with the Michigan Plumbing Code. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag-in line and pull past each joint as it is completed.
- F. Install building drain pitched down at minimum slope of ¼-inch per foot (2 percent) for piping 3-inch and smaller, and 1/8-inch per foot (1 percent) for drainage piping 4-inch and larger.
- G. Extend building drain to connect to sewer piping, of size and in location indicated for service entrance to building. Sewer piping is specified under separate Sections of Divisions 31 and 33.
- H. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

3.04 Installation of Piping Specialties

- A. Install expansion joints on vertical risers as indicated and as required by the Plumbing Code.
- B. Install cleanouts in above-ground piping and building drain piping as indicated, and:
 - 1. As required by Plumbing Code;
 - 2. At each change in direction of piping greater than 45 degrees;
 - 3. At minimum intervals of 50 feet for piping 4-inch and smaller and 100 feet for larger piping; and
 - 4. At base of each vertical soil or waste stack.
- C. Install floor and wall cleanout covers for concealed piping, types as indicated.
- D. Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
- E. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.
- F. Frost-proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.05 Installation of Floor Drains

- A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Install floor drains at low points of surface areas to be drained or as indicated. Set tops of drains flush with finished floor.
- C. Set drain elevation depressed below finished slab elevation as listed below to provide proper slope to drain:

Depression (inches)	Radius of Area Drained (feet)
1-1/4	20
1-1/2	25

- D. Trap all drains connected to the sanitary sewer.
- E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membrane where penetrated.
- F. Position drains so that they are accessible and easy to maintain.

3.06 Connections

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the Plumbing Code.
 - 1. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.07 Field Quality Control

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - 3. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - 4. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the Plumbing Code.
- B. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.
- C. Prepare inspection reports, signed by the plumbing official.

- D. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, according to BOCA Plumbing Code P1702.5.1.
 - 1. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
 - 2. Prepare reports for tests and required corrective action.

3.08 Adjusting and Cleaning

- A. Clean interior of piping system. Remove dirt and debris as Work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.09 Protection

- A. Protect drains during construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

End of Section

Division 23
Heating, Ventilating and Air Conditioning (HVAC)

Section 23 0500

Common Work Results for HVAC

Part 1 General

1.01 Scope of Work

- A. This Section includes general provisions for all mechanical Work, inclusive of whatever miscellaneous material and/or equipment shall be required for successful operation of the mechanical systems as indicated on the Plans. This Section also includes requirements of electrical equipment, such as motor starters, controls, and instruments when furnished as components of the mechanical equipment or system.

1.02 Related Work Specified Elsewhere

- A. Section 09 9100: Painting
- B. Section 26 0500: Common Work Results for Electrical

1.03 Reference Standards

- A. These standard specifications have been prepared by authorities which are recognized by the mechanical trades. The names of these authorities are listed below together with the abbreviations of their names as they appear in the following Specifications:
 - 1. ASA - American Standards Association
 - 2. ASTM - American Society for Testing Materials
 - 3. AMCA - Air Moving and Conditioning Association
 - 4. AFBMA - Antifriction Bearing Manufacturing Association
 - 5. ASHRAE- American Society of Heating, Refrigerating & Air Conditioning Engineers
 - 6. ASME - American Society of Mechanical Engineers
 - 7. NEMA - National Electrical Manufacturers' Association
 - 8. AWWA - American Water Work Association
 - 9. UL - Underwriters Laboratories, Inc.
 - 10. FM - Factory Mutual
 - 11. NFPA - National Fire Protection Association
 - 12. ANSI - American Standards Association

1.04 Quality Assurance

- A. Workmanship:
 - 1. Work shall be performed in accordance with latest accepted standards and practices for the trades involved. The workmanship shall be subject to the approval of ENGINEER.
 - 2. Only craftsmen experienced in the Work to be performed will be allowed to do the Work. This applies particularly to skilled trades such as welding, pipe fitting, plumbing, and sheet metal work.
- B. Codes, Ordinances, Permits, and Inspections:
 - 1. Materials and equipment required for the Work and their installation shall conform to the laws of the state of Michigan and to codes, rules, regulations, and ordinances of the locality where the Work is to be performed.

2. CONTRACTOR shall secure all permits, licenses, inspections and tests required in connection with his Work.
3. Upon completion of the Work, CONTRACTOR shall secure and present to OWNER a certificate of inspection and approval from the department having jurisdiction over his Work, if such be issued. Fees in connection with the above requirements shall be paid by CONTRACTOR.
4. Changes in the drawings and/or Specifications required to conform to the above codes, laws, rules and/or regulations shall be taken up with ENGINEERS' office by CONTRACTOR before submitting his proposal.
5. After entering into the Contract, CONTRACTOR shall be held to make all changes required to conform to the above ordinances, laws, rules, and/or regulations without extra expense to OWNER, except in the instance of ordinances, laws, rules, and/or regulations which are revised or enacted subsequent to the time of signing the Contract.

C. Design Drawings:

1. General arrangements, design, and extent of the mechanical Work prescribed in these Specifications are indicated and/or detailed on the accompanying drawings. Any discrepancies which may occur on the drawings and/or in the Specifications shall be called to the attention of ENGINEER. No changes or alterations in the Work shall be made because of said discrepancies until approval of such changes or alterations has been secured from ENGINEER.
2. In the event of disputes arising because of discrepancies between drawings of the Architectural, Mechanical, and/or Electrical Trades, such disputes shall be taken up with ENGINEER whose decisions will be final.
3. Dimensions which tie mechanical and/or electrical installations to the building structure shall be thoroughly field checked for accuracy and possibility of interferences due to field conditions. Ignorance of such field conditions because of CONTRACTOR's failure to field check the dimensions in question will be no excuse for additional compensation.

D. CONTRACTORS' Interface:

1. CONTRACTOR shall be responsible to coordinate the furnishing and installation of all materials and labor required for a complete and operable facility.
2. CONTRACTOR shall be responsible to include adequate appurtenances to complete installation of equipment furnished by him when furnished as an integral part of a packaged piece of equipment or integral mechanical equipment system.
3. CONTRACTOR shall be responsible for furnishing and installing the necessary piping to provide a complete and operable installation of all equipment and fixtures whether or not said equipment and fixtures are furnished by CONTRACTOR.

E. Apportionment of the Work:

1. CONTRACTOR shall classify and apportion all materials and performance of labor to the several trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions, etc., insofar as they may apply and as required to efficiently execute the Work involved in this Contract regardless of the classification indicated in these Specifications.

F. Locations:

1. Process equipment, plumbing fixtures, and mechanical equipment shall be in the exact locations as determined by ENGINEER. It shall be the duty of CONTRACTOR to request such exact locations from ENGINEER sufficiently in advance of the time when such information will be required at the buildings so as not to interfere with progress of his Work.

G. Points of Termination:

1. The points of connection and termination of the Work under these sections of the Specifications are shown on the drawings or stated in the Specifications, but in case of doubt as to such points of connection or termination, the decision of ENGINEER shall be final.

H. Local Utilities:

1. CONTRACTOR shall be responsible for coordinating, obtaining service, including costs and advising ENGINEER and utility company(s) as to installation schedules.

1.05 Submittals

A. Shop Drawings and Manufacturer's Data:

1. Submit shop drawings and/or manufacturer's data as required in Section 01300, Submittals. Shop drawings used during construction as temporary record documents shall comply as specified within these Contract Documents.

B. Operation and Maintenance Data:

1. CONTRACTOR shall submit operating instructions, repair parts lists, equipment manuals, and automatic control diagrams. Submittals shall be as required in Section 01300, Submittals. In addition, one copy of each automatic temperature control diagram shall be framed and glazed, and wall mounted in an area designated by OWNER, showing all temperature controls relating to equipment.
2. CONTRACTOR shall also provide ENGINEER with additional copies of the above material, each copy to be bound in book or pamphlet form with approved fastenings and covers. Each bound copy shall include a set of the final and approved shop drawings of all equipment, fixtures, and accessories used on this Project.

C. Record Drawings:

1. Submit record drawings as required in Section 01 7000, Contract Closeout. Drawings shall be 24" x 36" mylars of the Plans obtained from ENGINEER and paid for by CONTRACTOR, clearly marked by CONTRACTOR with accurate field

dimensions locating mechanical systems, equipment, piping, component parts, etc.

1.06 Product Delivery, Storage, and Handling

A. Storage:

1. Erect and maintain a weatherproof storage shed or weatherproof storage trailer on the premises, as necessary, of sufficient size to adequately receive and house the miscellaneous equipment and materials subject to damage by exposure to the weather.
2. Storage facility shall be located after consultation with ENGINEER and OWNER. The OWNER reserves the right to deny CONTRACTOR the privileges of storing material onsite.

1.07 Job Conditions

A. Protection:

1. Pipe ends, and parts of equipment left unconnected shall be capped, plugged or properly covered to prevent the intrusion of foreign matter.
2. The use of tarpaulins or plastic sheets for temporary enclosures, protection of materials, etc., will not be permitted in areas where burning and/or welding operations are going on or in any location where there may be the slightest hazard of their use contributing to a fire.

B. Sequencing:

1. CONTRACTOR shall be responsible for sequencing the Work of Subcontractors to avoid interferences and delays. Additional costs incurred as a result of changes in the Work to avoid interferences or delays shall be at the expense of CONTRACTOR.

C. Cutting and Patching:

1. Minor cutting that may be necessary for the installation of the Work and minor patching as a consequence thereof shall be done by CONTRACTOR after review by ENGINEER.
2. Major cutting of the structure necessary for the installation of the mechanical Work and major repairs required as consequence thereof shall be done by CONTRACTOR, after review by ENGINEER.

Part 2 Products

2.01 Materials

- A. When specific manufacturers or trade names are mentioned in these Specifications, and/or on the drawings, they are used as the design criteria and to establish a minimum of quality standard.

- B. Any substitution made that may affect building size or process function shall be deemed to be made for the convenience of CONTRACTOR, and all shall be brought to the attention of ENGINEER at an early date for consideration. Additional costs resulting therefrom shall be borne by CONTRACTOR.
- C. CONTRACTOR shall accept full responsibility that said substitution shall function as required by the process and shall not require additional building space or additional structural requirements. CONTRACTOR shall also be responsible for all redesign expenses incurred because of the substitution.
- D. Items required to complete the Work and not specifically mentioned herein, shall conform fully to the quality pattern established by these Specifications.
- E. Materials shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected by CONTRACTOR. ENGINEER reserves the right to disapprove and reject any materials, proposed or installed which fail to meet these quality standards. CONTRACTOR shall, at his own expense, remove and replace with approved materials, any materials which do not comply with these standards.
- F. Electrical equipment furnished under Division 15 of these Specifications shall be in full compliance with Division 16 of these Specifications.

2.02 Fabrication

- A. Provide for possible adjustments in the field of mechanical work fabrications. Adjustments shall allow for adjustment to avoid interferences, installation of equipment or connecting to other Work.

2.03 Equipment

- A. General:
 - 1. Unless furnished as integral parts of mechanical equipment, appurtenances such as remote operation switches or push buttons, pilot lights, starter relays, overloads or other items shall conform to and be installed as specified herein and any related Sections.
- B. Motors:
 - 1. General: Electric motors furnished as a part of the mechanical equipment shall conform to the detailed provisions in Division 26.
 - 2. Starters: Manual and magnetic starters furnished as a part of the mechanical equipment shall conform to the detailed provisions in Division 26.

Part 3 Execution

3.01 Contractor's Verification

- A. Verify location for installation of mechanical Work by field checking proper placement, possible interferences, and points of connection or termination.

- B. Verify opening clearances required for unobstructed passage of equipment or fabricated Work. Large equipment or fabrications shall be installed before buildings or structures are installed or completed.
- C. Additional cost for extra Work and/or delay in the Work because of failure by CONTRACTOR or a Subcontractor to verify locations, field conditions, or obstructions shall not be the responsibility of OWNER.

3.02 Installation

A. Structural Cutting:

- 1. Cutting of walls, floors, etc., for the installation of mechanical Work shall be done only when approved by ENGINEER. CONTRACTOR may allow Subcontractors to do minor cutting and patching, however, major cutting and repair shall be made by CONTRACTOR.

B. Equipment:

1. General:

- a. CONTRACTOR's attention is directed to the fact that certain equipment, (fans, drives, and other machinery), must be installed before housing and/or enclosures are installed or completed. Doors and other access openings in some cases are not large enough to permit passage of the equipment completely assembled. CONTRACTOR shall thoroughly investigate these conditions prior to fabrication or shipment.
- b. Component parts furnished as part of a packaged equipment system shall be installed with the mechanical Work, ready for connection as specified in Section 26 500, Common Work Results for Electrical. Electrical connection between component mechanical parts shall be inclusive to mechanical Work.
- c. Components such as remote operation controls, pilot lights, overloads or others not furnished as integral packaged pieces of equipment shall conform to and be installed as specified in Section 40 9000, Process Instrumentation, Controls, and Monitoring Equipment.
- d. Supports and Anchors: Provide bases, pads, platforms, hangers, clamps, or embedded inserts necessary for proper support and/or anchoring of mechanical Work. Detailed specifications for anchoring are included in other Sections of these Specifications.

2. Electrical Service:

- a. CONTRACTOR shall furnish all motors required in connection with his Work and he shall mount or install all his motors in their finished locations.
- b. Electrical components required and furnished for mechanical equipment systems provided as complete system by the manufacturer or Mechanical Subcontractor, and automatic temperature control systems together with any power and control interface wiring shall be the responsibility of

CONTRACTOR. He shall perform this Work in accordance with requirements of the electrical Specifications. CONTRACTOR shall be responsible for the proper operation of his equipment and shall furnish all wiring and control diagrams to ensure proper operation of same.

C. Painting:

1. Painting of installed piping, ducts, or equipment shall be in accordance with Section 09 9100, Painting.

D. Sleeves:

1. Provide sleeves where pipes or ducts pass through walls or floors necessary for installation and as specified elsewhere for mechanical Work. Sleeves for covered pipe or ducts shall be of proper size to allow the covering to pass through unless otherwise directed or specified elsewhere.

E. Plates:

1. Ceiling, floor or wall plates shall be installed at points where exposed pipes pass through walls, ceiling, or floors. Plates shall be nickel-plated sectional, pressed steel plates with positive catches.

F. Lubrication of Equipment:

1. After installation of any equipment is complete such as motors, pumps, compressors, etc., which depends on lubrication for efficient operation, they shall be lubricated in accordance with the manufacturer's recommendations. Lubrication shall be done before any test runs will be permitted or equipment placed in final operation.

G. Identification:

1. Mechanical equipment including pumps, air handling units and each and every valve and regulator shall be identified in accordance with other Sections of these Specifications.

3.03 Field Quality Control

A. Testing:

1. During and after installation, those tests required by the local, county and state inspection bureaus, OWNER or ENGINEER, shall be performed in strict accordance with the department concerned and at the full expense of CONTRACTOR.
2. CONTRACTOR shall furnish all equipment, water, compressed air, apparatus, and labor necessary for the test. Defects disclosed by the tests shall be rectified by CONTRACTOR without cost to OWNER. Test shall be made under the direction of and subject to the approval of OWNER or ENGINEER. Tests required after installation are outlined herein and shall endure for not less than 48 hours.
3. Equipment shall be tested as in normal operating service unless specific rating tests are required as results of questionable performance.

4. Gages and equipment, etc., which may be damaged by the tests shall be valved off or removed before testing.
 5. Special tests required for certain apparatus are specified under the specific headings for that apparatus.
 6. In general, all visible or audible leaks shall be fixed regardless of previous testing results.
- B. Final Inspection:
1. Upon completion of the Work, CONTRACTOR shall conduct a complete inspection of all items of Work instituted by the Contract obligations; and make whatever corrections and adjustments deemed necessary to a well functioning system, same to meet the satisfaction of ENGINEER and OWNER.
 2. CONTRACTOR shall signify his readiness for final inspection in writing to ENGINEER. Time of inspection may occur at the time of "Operating and Instructions." Inspection shall be made in the presence of OWNER and ENGINEER.
- C. Equipment Start-Up:
1. After completion of the installation, systems and equipment shall be tested by CONTRACTOR in the presence of ENGINEER under actual operating conditions. Tests shall be performed according to manufacturer's recommendations.
 2. CONTRACTOR shall include with his bid the services of all required equipment manufacturer's field service technician for a period necessary to complete the work to the satisfaction of ENGINEER and OWNER.
 3. This service shall be for the purposes of check-out, initial start-up, certification, and instruction of plant personnel.
 4. A written report covering the technician's findings and installation approval shall be submitted to ENGINEER covering all inspections and outlining in detail any deficiencies noted.
 5. Specific requirements, if any, for a particular system or piece of equipment are contained in the particular specification sections. CONTRACTOR's responsibility relative to coordinating these services are contained in Section 01 7000.

3.04 Cleaning and Adjustment

- A. Before turning the building(s) over to OWNER, clean all fixtures, piping, covering, exposed metal surfaces and leave in clean condition at the end of the Work and remove from the premises refuse, dirt and rubbish which are a result of the mechanical Work or workmen. Also, remove from the premises all cartons, scrap, and major debris at least once a week during progress of the Work.
- B. Upon completion of the plumbing system(s), CONTRACTOR shall adjust regulating valves for fixtures and equipment, etc., to provide proper and adequate flow.

- C. Instruments used in the checking, adjusting, and balancing shall be accurately calibrated and maintained. Accuracy tests on instruments shall be performed in the presence of and whenever requested by OWNER or ENGINEERS.
- D. After the cleaning and decorating of the buildings has been completed, CONTRACTOR shall thoroughly clean heating units, unit heaters, including coils and filters, elements, and inside of enclosures to completely remove the construction dust and dirt from same.
- E. Flush and clean the heating apparatus and system(s) for not less than four hours, using a standard accepted cleaning compound.
- F. Air and water balance and checking shall not begin until the system(s) has been completed and is in full working order. CONTRACTOR shall put heating, ventilating, and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.
- G. Two weeks after turning the systems over to OWNER, CONTRACTOR shall return to the building(s) and clean and check strainers, controls, and accessories.

End of Section

Section 23 0553

Identification for Mechanical Piping and Equipment

Part 1 General

1.01 Scope of Work

- A. This Section includes methods for identifying mechanical piping and equipment, including equipment labels, pipe labels, valve tags, valve schedules, and warning tags.

1.02 Submittals

- A. Shop Drawings and product data shall be submitted in accordance with Section 01 3300, Submittal Procedures, for each type of product indicated in this section.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.03 Reference Standards

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for viewing angles of identification devices for piping.

1.04 Coordination

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.

Part 2 Products

2.01 Equipment Labels

- A. Plastic Labels:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 degrees Fahrenheit.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1-1/2 by 4 inches.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content:
1. Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.02 Pipe Labels

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.03 Valve Tags

- A. Valve Tags: 0.032-inch thick brass.
 1. Data: Service, identification number, and temperature of the line controlled.
 2. 1-inch x 2-1/2 inch with lettering 5/16 inch high.
 3. Fastener: Brass chain or S-hook.

Part 3 Execution

3.01 Preparation

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 Equipment Label

- A. Install or permanently fasten labels on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible.
- B. Locate equipment labels where accessible and visible.
- C. Include nameplates for the following general categories of equipment:
 - 1. Packaged Outdoor Fixed Plate Energy Recovery Units.
- D. Equipment Marker Installation: Install with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

3.03 Pipe Label

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as removable accessible ceiling shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. At least once in each space, at least once every 20 feet, spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Anchor piping labels at each end with adhesive arrow bands around the full circumference of the pipe and overlapping at the ends. Adhesive arrow bands shall have a background color that is coded in accordance with the following table. If the stated background color is not commercially available, incorporate arrows into the label and provide color-coded bands without arrows.

Service	Background Color
Gas	Green

- D. Orient adhesive labels parallel to the pipe and locate labels where they can be read from the floor or the most likely approach for access.
- E. Where exposed pipes in occupied areas are to be painted, the color will be specified by the Architect for aesthetic purposes. The term “exposed” in this context means unhidden by architectural elements, not uninsulated.
- F. On all piping, apply labels stating “asbestos free” at least once in each space, at least once every 20 feet, and within 6 inches of each point of connection with existing piping insulation. Mark the circumference of the new insulation with a black marking pen at each point of connection with existing insulation and draw an arrow from the nearest “asbestos free” to the black line. On the arrow, write with the black marker “terminates here.”
- G. Connect piping to appliances using manual gas shutoff valves, appliance pressure regulators, and unions. Install valve within 72 inches of each gas fired appliance and equipment. Install union between valve and appliances or equipment.
- H. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

End of Section

Section 23 0593

Testing, Adjusting, And Balancing For HVAC

Part 1 General

1.01 Summary

- A. This Section includes testing, adjusting and balancing HVAC systems to provide design conditions as indicated by the associated drawings. This Section includes, but is not limited to the following:
 - 1. Balancing Air Systems - Constant-air-volume systems.
 - 2. Measuring the electrical performance of HVAC equipment.
 - 3. Verification that automatic control devices are functioning properly.
 - 4. Reporting results of the activities and procedures specified in this Section.

1.02 Definitions

- A. AABC: Associated Air Balance Council.
- B. Adjust: To regulate fluid flow rates and air patterns at the system or terminal level. At the system level an example would be reducing fan speed; at the terminal level an example would be changing a damper position.
- C. Balance: To proportion air or water flows within the distribution system, including submains, branches and terminals with respect to design quantities.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. Independent: Not affiliated with or in employment of any Contractor.
- F. NEBB: National Environmental Balancing Bureau.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- M. TAB: Testing, adjusting, and balancing.
- N. TABB: Testing, Adjusting, and Balancing Bureau.

- O. TAB Specialist: An entity engaged to perform TAB Work.
- P. Testing, Adjusting and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- Q. Terminal: A point where the controlled medium (fluid or energy) enters or leaves the distribution system.

1.03 Submittals

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.04 Quality Assurance

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect and Commissioning Authority.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

Part 2 Products (Not Applicable)

Part 3 Execution

3.01 Examination

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine equipment performance data including fan curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine heat-transfer static plates for clean and clear air path.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 Preparation

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance dampers are open.
 - 5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 General Procedures for Testing And Balancing

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2016, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 General Procedures for Balancing Air Systems

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check for proper sealing of air-handling-unit components.
- J. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.05 Procedures for Constant-Volume Air Systems

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.

- c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 Procedures for Motors

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase, 100% speed.
 6. Nameplate and measured amperage, each phase, 100% speed.
 7. Starter thermal-protection-element rating.
 8. Current limit setting on Variable Frequency Drive.
 9. Minimum speed setting on Variable Frequency Drive.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. **Test the manual bypass of the controller to prove proper operation.** Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.07 Tolerances

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Zero to Plus 5 percent.
 2. Air Outlets and Inlets: Plus or minus **10** percent.

3.08 Reporting

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare bi-weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.09 Final Report

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.

- c. Fan drive settings.
- d. Other system operating conditions that affect performance.

End of Section

Section 23 0900 HVAC Control Systems

Part 1 General

1.01 Scope of Work

- A. Control Systems Work, including control sequences, as indicated on Drawings and by requirements of this Section.

1.02 Related Work Specified Elsewhere

- A. Refer to Division 26 Sections for the following Work:
 - 1. Power supply wiring from power source to power connection on controls and/or unit control panels. Include starters, disconnects, and required electrical devices, except where specified as furnished or factory installed by manufacturer.
 - 2. Interlock wiring between electrically operated equipment units and between equipment and field-installed control devices.
 - 3. Interlock wiring specified as factory installed, is Work of this Section.
- B. Provide the following electrical work as Work of this Section, complying with requirements of Division 26.
 - 1. Control wiring between field-installed controls, indicating devices and unit control panels.

1.03 System Description

- A. Temperature Control Sequence of Operation:

The heat recovery unit (HRU-1) shall run continuously including the supply and exhaust fans while the building is in operation. The unit is supplied with an on/off/auto switch. When the switch is in the auto position the units on/off operation will be controlled by the central DDC plant control system. The unit shall be provided with a BACnet IP card with discoverable points. The integration to the front-end controls is by the owner.

When the unit is on the supply air inlet and outlet dampers and return air inlet and outlet dampers open. Blowers will delay on and run continuously. The unit controller with an integral reference setpoint fixed at 65°F will modulate the gas flow and combustion air to maintain the required discharge air temperature at 65°F. When room thermostat calls for heat the discharge temperature will be reset to 80°F to satisfy the required room temperature. When the unit is off, all dampers close. Integral auto bypass low limit will stop unit operation if the discharge air temperature falls below 40°F. Heating is locked out above 70° ambient (adjustable).

1.04 Submittals

- A. Shop Drawings and Product Data:

1. Shop Drawings: Submit in accordance with Section 01 3300, Submittal Procedures, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - a. Manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Include installation and start-up instructions.
 2. Shop Drawings for each control system containing the following information:
 - a. Label each control device with setting or adjustable range of control.
 - b. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
 - c. Complete written verbal description of sequence of operation for each system.
- B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01 6000, Product Requirements, operation and maintenance manuals for items included under this Section.

1.05 Quality Assurance

- A. Reference Standards:
1. Electrical Standards: Provide electrical components of control systems, which have been UL listed and labeled, and comply with NEMA standards.
 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
 3. NFPA Compliance: Comply with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," where applicable to controls and control sequences.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of control equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

1.06 Service and Warranty

- A. Under Temperature Control all thermostats, motors, and other equipment provided under this Contract shall be adjusted. The equipment shall be placed in complete operating condition subject to the approval of ENGINEER, and the operating personnel shall be instructed in the operation of the control system.
- B. The control system as shown on Drawings and specified herein shall be guaranteed free from defects in workmanship and material under normal use and service for a period of 1 year after acceptance of ENGINEER.

- C. Equipment described herein proven to be defective in workmanship or material during the warranty period shall be adjusted, repaired, or replaced by the manufacturer at no charge to OWNER.

1.07 Delivery, Storage, and Handling

- A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons while shipping, storage, and handling as required to prevent equipment damage and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

Part 2 Products

2.01 Manufacturers

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. Line Voltage Thermostat:
 - a. Honeywell, Model T6051A.
 - b. Robertshaw
 - c. Emerson

2.02 Materials and Equipment

- A. Provide control products in sizes and capacities indicated, consisting of dampers, thermostats, controllers, and other components as required for complete installation.
- B. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- C. Provide control systems with the following functional construction features:
 - 1. Temperature Control Equipment:
 - a. Electric Control Systems:
 - (1) Line Voltage Thermostat: Thermostats shall be line voltage bimetal type instruments and rated for 16 amps at 120V. Thermostats shall be provided with Fan-Off-Auto subbase and shall have a setpoint range of 46-84 degrees F and a fixed differential of 1-degree F.

Part 3 Execution

3.01 Acceptable Installers

- A. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years.

3.02 Inspection

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.03 Installation of Control Systems

- A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings, and details shown on Drawings. All piping shall be concealed except in mechanical rooms or areas where other piping is exposed.

3.04 Adjusting and Cleaning

- A. Start-up, test, and adjust control systems in presence of Owners authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
- C. Final Adjustment: After completion of installation, adjust thermostats, motors, and similar equipment provided as Work of this Section.

End of Section

Section 22 1616 Natural Gas Piping

Part 1 General

1.01 Related Documents

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 Summary

- A. Section Includes:
 - 1. Aboveground pipe and fittings from meter and main regulator to building equipment.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.03 Reference Standards

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. 2015 Edition of the International Fuel Gas Code.
 - 2. Latest Edition of NFPA 54, National Fuel Gas Code.

1.04 Performance Requirements

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 5.0 psig or less

1.05 Submittals

- A. Product Data: For each type of product indicated.
- B. Welding certificates.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.06 Quality Assurance

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience.

1.07 Delivery, Storage and Handling

- A. Accept valves on Site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

Part 2 Products

2.01 General

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 Pipes, Tubes, And Fittings

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

2.03 Joining Materials

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 Gas Valves

- A. All valves shall be designed, manufactured and approved for natural gas service.
- B. Line Shut-off Valves sizes 2 inches and smaller shall be iron body lubricated plug valve conforming to ASTM-A-126, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and -20 to 200 degrees F., manufactured by Nordstrom Model 142 or equal by Resun or McDonald, A. Y. Mfg. Co.
- C. Appliance/Equipment Shut-off Valves at local connections sizes 2 inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275 degrees F., manufactured by Nibco Model T585-70-UL or equal by Milwaukee or Apollo.

2.05 Pressure Regulators

- A. General Requirements:
 - 1. Single stage and suitable for natural gas.
 - 2. Steel jacket and corrosion-resistant components.
 - 3. Elevation compensator.
 - 4. End Connections: Threaded for regulators NPS 2 and smaller.
- B. Appliance Pressure Regulators: Comply with ANSI Z21.18.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Itron
 - b. Elster American Meter
 - c. Marsh Bellofram - BelGas
 - 2. Body and Diaphragm Case: Die-cast aluminum.
 - 3. Springs: Zinc-plated steel; interchangeable.
 - 4. Diaphragm Plate: Zinc-plated steel.
 - 5. Seat Disc: Nitrile rubber.
 - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 - 7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
 - 8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
 - 9. Maximum Inlet Pressure: 5 psig

2.06 Dielectric Unions

- A. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Hart Industries International, Inc.
- b. McDonald, A. Y. Mfg. Co.
- c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- d. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 125 psig 180 deg F.
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

Part 3 Execution

3.01 Indoor Piping Installation

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Locate valves for easy access.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Verify final equipment locations for roughing-in.
- J. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- K. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- L. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- M. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- N. Connect branch piping from top or side of horizontal piping.

- O. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- P. Do not use natural-gas piping as grounding electrode.
- Q. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- R. Install pressure gage downstream from each line regulator.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors, concrete walls or slabs. Comply with requirements for sleeves specified in Division 23 Section "Common Work Results for HVAC."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Common Work Results for HVAC."

3.02 Valve Installation

- A. Install manual gas shutoff valve for each gas appliance.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.03 Piping Joint Construction

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.04 Hanger and Support Installation

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.05 Connections

- A. Connect to utility's gas main after meter and regulator.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.06 Labeling and Identifying

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.07 Field Quality Control

- A. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.08 Outdoor Piping Schedule

- A. Aboveground natural-gas piping 2" and smaller shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- B. Aboveground outdoor piping shall be provided with factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

3.09 Indoor Piping Schedule

- A. Aboveground, branch & distribution piping NPS 2 and smaller shall the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, branch & distribution piping larger than NPS 2 shall the following:
 - 1. Steel pipe with wrought-steel fittings and welded joints.

End of Section

Section 23 3113

Metal Ducts

Part 1 General

1.01 Summary

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Sheet metal materials.
 - 3. Sealants and gaskets.
 - 4. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 Performance Requirements

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.

1.03 Submittals

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Factory- and shop-fabricated ducts and fittings.
 - 2. Fittings.
 - 3. Seam and joint construction.
 - 4. Equipment installation based on equipment being used on Project.
 - 5. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings (For information only, not a reviewed submittal): Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

Part 2 Products

2.01 Rectangular Ducts and Fittings

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 Sheet Metal Materials

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M G90.
 1. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 Sealant and Gaskets

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL. The entire perimeter of all joints shall be sealed.

1. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.04 Hangers and Supports

- A. Hanger Rods: Electrogalvanized, all-thread rods or galvanized rods with threads.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

Part 3 Execution

3.01 Duct Installation

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 Installation of Exposed Ductwork

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
 - a. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- B. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

3.03 Duct Sealing

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Conditioned Space, Supply and Return-Air Ducts: Seal Class C.

3.04 Hanger and Support Installation

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 Connections

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 Start Up

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.07 Duct Schedule

- A. Duct dimensions shown are free inside dimensions and shall be followed unless job conditions require alterations. Duct size revisions shall be based on the equal friction method.
- B. Fabricate ducts with galvanized sheet steel.
- C. Intermediate Reinforcement shall match duct material
- D. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- E. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

End of Section

Section 23 3300

Air Duct Accessories

Part 1 General

1.01 Summary

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors.
 - 5. Flexible connectors.
 - 6. Duct accessory hardware.

1.02 Submittals

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.03 Quality Assurance

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

Part 2 Products

2.01 Materials

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 Dampers –Volume

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff
 - 5. Ruskin Company.

2.03 Manual Volume Dampers

- A. Damper and blade material to match ductwork material
- B. Standard leakage rating.
- C. Suitable for horizontal or vertical applications.
- D. Frames:
 - 1. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - 2. Mitered and welded corners.
 - 3. Flanges for attaching to walls and flangeless frames for installing in ducts.
- E. Blades:
 - 1. Rectangular dampers shall be single blade type in ducts up to 11" high and shall be opposed blade type in ducts 12" high and above.
 - 2. Round dampers shall be single blade type.
 - 3. Stiffen damper blades for stability.
- F. Provide end bearings on all dampers. On multiple blade dampers bearing shall be oil-impregnated nylon or sintered bronze.
- G. Provide locking indicating quadrant regulators on all dampers. Where rod lengths exceed 30-inches, provide a regulator at both ends.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- I. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
 - 4. Damper Hardware:
 - a. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - b. Include center hole to suit damper operating-rod size.

- c. Include elevated platform for insulated duct mounting.

2.05 Flexible Connectors

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Material shall be crimped into a metal edging strip and shall be approximately 3 inches wide.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 degrees Fahrenheit.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 degrees Fahrenheit.

2.06 Flange Connectors

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.07 Turning Vanes

- A. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- B. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.08 Duct-Mounted Access Doors

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.

- b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.

2.09 Duct Accessory Hardware

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

Part 3 Execution

3.01 Installation

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Maximum 50-foot spacing.
 - 2. Upstream from turning vanes.
 - 3. Control devices requiring inspection.
 - 4. Elsewhere as indicated.

- G. Install access doors with swing against duct static pressure.
- H. Access Door Sizes:
 - 1. Two-Hand Access: 12 by 6 inches.
- I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- J. Install flexible connectors to connect ducts to equipment.

3.02 Field Quality Control

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.

End of Section

Section 23 3713

Registers And Grilles

Part 1 General

1.01 Summary

- A. Section Includes:
 - 1. Fixed face registers and grilles.

1.02 Submittals

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

Part 2 Products

2.01 Acceptable Manufacturers:

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 - 1. Titus.
 - 2. Price Industries.
 - 3. Krueger.
 - 4. Tuttle & Bailey.

2.02 Registers and Grilles

- A. Rectangular Supply Grille (SG-1):
 - 1. Single 35-degree fixed deflection and 1-1/4" border Front blades parallel to long dimension.
 - 2. Border Material – Steel.
 - 3. Finish: Baked enamel, off-white.
 - 4. Damper Type: Adjustable opposed blade.
 - 5. Shall be equivalent to Titus Model 300RS.
- B. Rectangular Exhaust Grille (EG-1):
 - 1. Single 35 degree fixed deflection and 1-1/4" border.
 - 2. Border Material - Steel.
 - 3. Finish: Baked enamel, off-white.
 - 4. Damper Type: Adjustable opposed blade.
 - 5. Shall be equivalent to Titus Model 350RL.
- C. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

Part 3 Execution

3.01 Installation

- A. Install registers, and grilles level and plumb.
- B. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. Where items conflict with installation, notify Engineer for a determination of final location.
- C. Install registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers.

3.02 Adjusting

- A. After installation, adjust registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

End of Section

Section 23 7223

Packaged Outdoor Fixed Plate Energy Recovery Units

Part 1 General

1.01 Scope of Work

- A. This Section includes wall fans, as indicated on Drawings and Schedules and by requirements of this Section.
- B. Power supply wiring from power source to power connection on fan motors. Include starters, disconnects, and required electrical devices, except where specified as furnished or factory installed by manufacturer.
- C. Interlock wiring between fan units; and between fans and field-installed control devices.
 - 1. Interlock wiring specified as factory installed, is Work of this Section.

1.02 Submittals

- A. Shop Drawings and Product Data:
 - 1. Shop Drawings: Submit in accordance with Section 01 3300, Submittal Procedures, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
 - a. Assembly-type Shop Drawings showing unit dimensions, required clearances, construction details, and field connection details.
 - b. Manufacturer's technical product data, including specifications, capacity ratings, fan performance curves with operating point clearly indicated, heat recovery performance, gauges and finishes of materials, dimensions, weights, accessories furnished, and installation instructions.
- B. Manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
- C. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01 6000, Product Requirements, operation and maintenance manuals for items included under this Section.

1.03 Reference Standards

- A. AMCA Compliance: Provide fans bearing the AMCA Certified Ratings Seal.
- B. UL Compliance: Provide fans electrical components which have been listed and labeled by UL.
- C. Comply with applicable requirements in ASHRAE 62.1-2016, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

1.04 Quality Assurance

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.05 Delivery, Storage, and Handling

- A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory fabricated, protective containers.
- B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.
- C. Store fans in clean, dry place and protect from weather and construction traffic.
- D. Comply with manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

1.06 Warranty

- A. Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
- B. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
- C. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
- D. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

Part 2 Products

2.01 Air Handling Units

- A. Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.
- B. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.
- C. Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal.
- D. Pre-wired air handling units shall bear an approved label with all the necessary identification marks, and electrical data.
- E. All electrical circuits shall undergo a dielectric strength test and shall be factory tested and checked as to proper function.

- F. The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.
- G. Air Handling Units shall be ETL Approved and as manufactured by Engineered Air and be base bid. Alternate products must show savings and clearly indicate all areas where they do not meet specified product.

2.02 Unit Construction

- A. Unit casing shall be of minimum 18-gauge epoxy painted steel exterior sheet metal.
- B. All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.
- C. Unit interior shall be provided with a 22-gauge solid, 304 stainless steel sheet metal.
- D. Screws and rivets shall be stainless steel or other non-corrosive material.
- E. Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, and burner compartments. Access doors for airside compartments to be deluxe welded type. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
- F. Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.
- G. All units shall be internally insulated with minimum 1" thick, 1 1/2 lb./cu.ft. density insulation.
- H. Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1" stainless steel inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" with three break interlocking design; outer wall panels extend a minimum of 1/4" below the floor panel; drain trap(s) connections for field supply and installation of drain traps.
- I. Where required, provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 12" high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" upturn on inner perimeter, to provide a complete seal against the elements. External insulation and flashing of roof-mounting curb shall be provided by the Roofing Subcontractor.
- J. Provide units with air intake hoods with birdscreen, all coated to match unit casing.

2.03 Fans and Motors

- A. Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

- B. Fans and housings shall be epoxy painted for corrosion resistance.
- C. Airfoil and BI fans shall be direct drive plenum type configuration where noted in schedules. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Fan wheels to be aluminum.
- D. Provide variable speed drives for fan motors.
 - 1. Adjustable frequency drive shall be NEMA 4X rated and be labeled by an approved testing agency such as UL.
 - 2. Line and load reactors required for all 460 and 575 volt applications.
 - 3. Drive shall be factory supplied and installed.
 - 4. Minimum CFM of 35% on gas fired heat exchangers.
- E. Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
- F. Fan motors shall be TEFC (totally enclosed fan cooled) Super E high efficiency.

2.04 Gas Heat Section - Indirect Fired

- A. Heating units shall be indirect natural gas fired. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.
- B. All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire operation.
- C. Operating natural gas pressure at unit(s) manifold shall be 7" w.c.

2.05 Heat Exchanger/Burner Assembly

- A. Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1" of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.
- B. The heat exchanger/burner assembly shall be a blow through positive pressure type. Units using continuous or intermittent pilots are not acceptable.
- C. Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

- D. The heat exchanger/burner assembly shall include 15:1 turndown. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.
- E. Factory testing of indirect fired gas heating section.
- F. Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.
- G. Heat exchanger shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold.
- H. High and Low input flue gas combustion analysis using a calibrated combustion analyzer including O₂ and CO to provide proper air fuel ratio throughout the entire operating range.

2.06 Controls

- A. Electronic DJM module (Modulating Fuel w/ Modulating Combustion Air) complete with proportional and integral control with discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. Combustion blower RPM shall be proved using a hall effect speed sensor. Two speed or step speed combustion blowers are not acceptable.
- B. Combustion efficiency of high efficiency heat exchangers shall increase by up to 1-3% from high fire to low fire while turning down on units incorporating 15:1 turndown (HT Burner). Heat exchangers shall provide a minimum of (80% DJE, DJS), efficiency throughout the entire operating range.

2.07 Filters

- A. Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side.
- B. Pre-filters: 2" Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Units exposed to 100% outside air shall have permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.
- C. Carbon filters (Alternate 1): 21.5" deep cassette filters, mounted in American Air Filter SAAF front access housings. Cassettes filled with AAF SAAFCarb MA.HT engineered chemical media. Carbon Filters will be on the exhaust air stream and bid as an alternate.

2.08 Dampers

- A. Extruded aluminum (6063-T5) damper frame shall not be less than 0.080" in thickness. Damper frame shall be 4" deep x 1", with duct mounting flanges on both sides of frame.

Damper frame shall have a 2" mounting flange on the rear of the damper when installed as Extended Rear Flange install type. Aluminum frame shall be clear anodized to a minimum thickness of 0.7 mil (18 microns) deep. Frame shall be assembled using stainless steel screws. Welded frames shall not be acceptable.

- B. Blades shall be maximum 6" deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06", clear anodized to a minimum thickness of 0.7 mil deep. Aluminum end caps shall be press fitted to blade ends in order to seal hollow interior and reduce air leakage rates. End caps shall be clear anodized. All blades shall be symmetrically pivoted.
- C. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.
- D. Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- E. Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
- F. Hexagonal control shaft shall be 7/16". It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be stainless steel.
- G. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.
- H. Dampers shall be AMCA rated for Leakage Class 1A at 1 in. w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- I. Acceptable product shall be TAMCO Series 1500 SW Enhanced Air-Foil Control Damper, as manufactured by T. A. Morrison & Co., Inc. (Tel: 1-800-561-3449, USA & Canada).

2.09 Factory Supplied Controls/Wiring

- A. Provide a system of motor control, including all necessary terminal blocks, VFD's, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.
- B. Gas fired units shall include high limit, low limit, and combustion airflow switch.
- C. Fire alarm circuits (where required) shall be powered from a relay in the unit circuitry.
- D. Factory installed and wired non-fused disconnect switch with NEMA 4X rating.
- E. Electrical enclosures shall be minimum NEMA 4X rated to protect against a corrosive environment.

- F. Exposed sensors shall be either conformal coated or air dry phenolic coating.
- G. Unit wiring shall be type THHN and shall be run in aluminum conduit with liquid tight fittings.
- H. Unit shall be provided with a BACnet IP interface. The owner will be integrating points to their front-end system outside of this contract. Visible points at a minimum shall include on/off status, heating status, supply and exhaust fan VFD speed, discharge air temp, ambient air temp, and unit in alarm. Contractor shall provide support to the district as needed for the integration.

2.10 Plate Heat Exchangers

- A. The units shall be Engineered Air packaged heat recovery units incorporating the air to air heat exchanger and auxiliary heating and/or cooling equipment. All units shall be factory assembled, wired and tested, and bear the cETL, ETL_{US} label.

2.11 Heat Exchanger

- A. The heat recovery section shall incorporate an air to air heat exchanger with epoxy coated aluminum plates and frame. It shall be of the cross flow design and so constructed to prevent any intermixing or cross contamination of the supply air and exhaust air streams. All joints shall be sealed with a sealant that is resistant to high and low temperatures. The standard heat exchanger shall be suitable for normal temperatures up to 212°F. The efficiency of the air to air heat exchanger shall be as specified in the unit schedule. The heat exchanger section shall be complete with 22 gauge solid liner.

2.12 Frost Prevention

- A. Bypass openings shall be provided with integral face and bypass dampers complete with controller to keep the heat exchanger exhaust air temperature above 32°F. The dampers, controller, and damper operator are to be factory installed and tested by Engineered Air.

2.13 Roof Curbs

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
- B. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I or II.
 - 2. Thickness: 1-1/2 inches.
- C. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - 1. Liner Adhesive: Comply with ASTM C 916, Type I.
 - 2. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - 3. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.

- 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- D. Curb Height: 14 inches.

Part 3 Execution

3.01 Installation

- A. Equipment Mounting: Install RTUs on concrete base using elastomeric pads.
- B. Minimum Deflection: 1/4 inch.
- C. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA or AHRI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- D. Unit Support: Install unit level on structural **curbs**. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
- E. Install piping adjacent to RTUs to allow service and maintenance.
- F. Gas Piping: Comply with applicable requirements in Division 22 Section Natural-Gas Piping. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- G. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
- H. Install ducts to termination at top of roof curb.
- I. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
- J. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- K. Install return-air duct continuously through roof structure.
- L. Install normal-weight, 3000-psi compressive strength (28-day) concrete mix inside roof curb, 4 inches thick. Concrete, formwork, and reinforcement are specified in Division 03.

3.02 Field Quality Control

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.03 Cleaning and Adjusting

- A. After completing system installation and testing, adjusting, and balancing the air handling unit and air-distribution systems, clean filter housings and install new MERV 8 filters.

End of Section

Division 26
Electrical

Section 26 0500

Electrical General Requirements

Part 1 General

1.01 Scope of Work

- A. The specifications of Division 26 and the accompanying drawings contemplate the furnishing and installation of materials, equipment, supplies, testing, adjustments, labor, and supervision required for the complete performance of operations relating to the electrical and instrumentation.
- B. CONTRACTOR shall be held responsible for the complete and satisfactory accomplishment of Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation and demonstrate that electrical systems will operate satisfactorily under normal operating conditions.
- C. CONTRACTOR shall be responsible for all electrical connections to equipment. Electrical connections in addition to making wire connections shall include, but not be limited to, furnishing, installing, and testing circuit protection devices, motor overload devices, conduits, and fittings needed to ensure a complete and operable electrical installation.

1.02 Related Work Specified Elsewhere

- A. Section 03 3000: Cast-in-Place Concrete
- B. Section 26 0510: Basic Materials and Methods

1.03 Responsibility

- A. It shall be the responsibility of CONTRACTOR to furnish a complete and fully operating system. CONTRACTOR shall be responsible for all details which may be necessary to properly install, adjust, and place in operation the complete installation. CONTRACTOR shall assume full responsibility for additional costs which may result from unauthorized deviations from the Plans and Specifications.

1.04 Apportionment of the Work

- A. CONTRACTOR shall classify and apportion materials and performance of labor to the several trades involved in accordance with all local customs, rules, regulations, jurisdiction awards, decisions, etc., insofar as they may apply and as required to efficiently execute the Work involved in this Contract.

1.05 Cooperation of the Contractor

- A. CONTRACTOR shall coordinate the work of Subcontractors of each trade to avoid interference in the Work and to avoid delays in the construction. He shall coordinate the Work of all Subcontractors to obtain a first-class workmanlike system.
- B. Where interference occurs as a result of poor cooperation between Subcontractors and the coordination on the part of CONTRACTOR, OWNER reserves the right to change the Work in hand to resolve the interferences and such changes will not be considered as extras.

1.06 Damage to Other Work

- A. CONTRACTOR will be held responsible for damage done by his workmen. Patching and repairing of damaged Work shall be done by CONTRACTOR.

1.07 Maintenance Prior to Final Acceptance

- A. CONTRACTOR shall be responsible for the maintenance of equipment and systems installed until final acceptance by OWNER and shall take such measures as necessary to ensure adequate protection of equipment and materials during delivery, storage, installation, start up, temporary operation, and shut down.

1.08 Accessibility

- A. Equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, subject to the approval of ENGINEER.

1.09 Cutting and Patching

- A. CONTRACTOR shall perform all cutting and patching that may be necessary for the installation of the Work.
- B. Major wall penetrations shall not be made without the written consent of ENGINEER unless they are called for on the construction drawings.
- C. Structural steel shall not be cut, welded, or altered in any way without the written consent of ENGINEER.

1.10 Reference Standards

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ANSI - The American National Standards Institute
 - 2. ASA - Acoustical Society of America
 - 3. ASTM - The American Society for Testing Materials
 - 4. ETL - Electrical Testing Laboratories
 - 5. IEEE - The Institute of Electrical and Electronic Engineers
 - 6. ICEA - The Insulated Cable Engineers Association
 - 7. ISA - The Instrument Society of America
 - 8. ITL - Independent Testing Laboratories
 - 9. JIC - Joint Industrial Conference
 - 10. NACE - National Association of Corrosion Engineers
 - 11. NEC - The National Electric Code
 - 12. NEMA - The National Electrical Manufacturers Association
 - 13. NESC - The National Electrical Safety Code
 - 14. NFPI - The National Fire Protection Institute
 - 15. OSHA - Federal Occupational Safety and Health Act
 - 16. UL - Underwriters Laboratories, Inc.
 - 17. FM - Factory Mutual Insurance Underwriters

1.11 Quality Assurance

- A. Erector Qualifications:

1. Work shall be performed in accordance with latest accepted standards and practices for the trades involved. Workmanship shall be subject to the approval of ENGINEER at all times.
2. Only experienced craftsmen will be allowed to perform the items of Work as required within this Project.

B. Requirements of Regulatory Agencies:

1. Materials and equipment required for the Work and their installation shall conform to national, state, county, and local codes, rules, regulations, and ordinances. Each contractor shall secure all permits, inspections, and tests required in connection with his Work.
2. Changes in the drawings and/or Specifications required to conform to the above codes, laws, rules, and/or regulations shall be taken up with ENGINEER by CONTRACTOR before submitting his Proposal. After entering into the Contract, CONTRACTOR shall be held responsible to make all changes required to conform to the above ordinances, laws, rules, and/or regulations without extra expense to OWNER, except in the instance of ordinances, laws, rules, and/or regulations which are revised or enacted subsequent to the time of signing the Contract.

1.12 Submittals

A. Schedule:

1. CONTRACTOR shall submit a schedule in accordance with Section 01 3300, Submittal Procedures, for review to ENGINEER outlining the steps to be taken to maintain electrical service and showing the coordination effort which will be taken to coordinate the work between the various trades.

B. Samples:

1. When directed by ENGINEER or required by the Specifications, CONTRACTOR shall submit samples of materials and accessory equipment such as lighting fixtures, switches, receptacles, etc.
2. CONTRACTOR shall not use these materials in the Work until ENGINEER has had ample time to determine the products suitability and compliance with the Specifications. In general, two weeks shall be considered ample time to approve or reject the submitted sample.

C. Shop Drawings and Product Data:

1. Submit shop drawings and product data as required in Section 01 3300, Submittal Procedures.
2. CONTRACTOR shall submit the following types of information for approval by ENGINEER before any equipment is installed:
 - a. Catalog Cuts and/or Product Data Sheets:

- (1) Catalog cuts shall be provided for standard manufactured items such as conduit and conduit fittings, electric heaters, lighting fixtures, lighting panels, instruments, motors, switches, transformers, wire, etc.
- (2) Each sheet shall identify the exact equipment for which it is intended.
- (3) All pertinent information such as physical dimensions, current rating, horsepower, kilowatt rating, phase, power factor, voltage, NEMA classifications, and material type shall be indicated.
- (4) Also shown shall be approved listings such as UL label or other testing agencies.

b. Vendors Standard Drawings:

- (1) 24" x 36" drawings are preferred, however, where a manufacturer's standard equipment is being used, his "full size" standard drawings may be submitted for approval provided the following information is included on the drawings:
 - (a) Identity of equipment for which drawing is intended.
 - (b) Optional features to be used for this Project identified.
 - (c) Field connections clearly identified complete with necessary terminal and wire numbers.
 - (d) Sequence of operation shall be written on the drawing unless the control diagram is easily understood without a sequence of operation.

c. Process Control Drawings:

- (1) CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.
- (2) Drawings shall be on 24" x 36", reproducible media, with border, title block, symbols, etc., as used on the Contract drawings and approved by ENGINEER.
- (3) Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc.
- (4) Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

D. Test Reports:

1. When directed, CONTRACTOR shall submit the manufacturer's test reports on any equipment proposed for this Project.

2. CONTRACTOR will maintain a complete set of test records covering all tests required by this Specification. The records will include the date, equipment or system tested, testing conditions, test results, and CONTRACTOR verification. Records will be available for review during construction and will be submitted to the ENGINEER upon completion of the Project.
- E. Certificates:
1. CONTRACTOR, upon completion of his portion of the Project, shall secure and present to ENGINEER a certificate of inspection and approval from the department having jurisdiction over his work, if such be issued. CONTRACTOR shall pay all fees in connection with the above requirements.
- F. Operation and Maintenance Data:
1. Provide maintenance manuals as required in 01 3300, Submittal Procedures, for the main switchgear, motor control centers and reduced voltage starters, and the main control/instrumentation panels.
- G. Record Drawings:
1. It shall be the responsibility of CONTRACTOR to provide all drawings pertaining to his Work. Drawings including both manufacturer's drawings and engineer design drawings shall be reproducible media electronic record drawings will be acceptable when approved by ENGINEER.
 2. The drawing set shall include:
 - a. A site plan and floor plans of each elevation showing the location of all equipment, lighting fixtures, embedded conduit, grounding, conduit size, conduit routing, wire size, etc.
 - b. Schematic ladder diagrams for each piece of equipment and system using JIC format.
 - c. Wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.
 3. CONTRACTOR shall accurately maintain the set of drawings and submit prints at various stages of the Work, upon request of ENGINEER. Final revised record drawings shall be turned over to ENGINEER upon completion or termination of CONTRACTOR's responsibility to this Contract.

1.13 Delivery, Storage, and Handling

- A. Storage:
1. Electrical equipment and materials shall be stored in a location and manner to protect against damage.
- B. Delivery and Handling:

1. Materials and equipment shall be delivered, unloaded, and handled in a manner to protect against damage. CONTRACTOR shall repair or replace all damaged or defective material at ENGINEER's option and at no cost to OWNER or ENGINEER.

1.14 Job Conditions

A. Existing Conditions:

1. CONTRACTOR shall be responsible for determining the existing conditions at the time the electrical work begins and arrange for surveys, trenching, concrete work, conduit sleeves, and any other work necessary to perform the electrical installation.

B. Environmental Requirements:

1. CONTRACTOR shall exercise caution during installation and afterward to assure all equipment is protected from adverse environmental conditions such as temperature, wind velocity, humidity, rain, ice, etc.

C. Protection of Work and Property:

1. Materials and equipment both before and after erection shall be properly protected and kept in a clean condition.
2. Conduit ends and parts of equipment left unconnected shall be capped, plugged or properly covered to prevent the intrusion of foreign matter.
3. The use of tarpaulins or plastic sheets for temporary enclosures, protection of materials, etc., will not be permitted in areas where burning and/or welding operations are going on or in any location where there may be the slightest hazard of their use contributing to a fire.
4. Equipment which has been installed and later becomes damaged shall be replaced or repaired at ENGINEER's option at CONTRACTOR's expense.

D. Sequencing:

1. CONTRACTOR shall so schedule his Work to assure that he does not delay the work of any other trades. He shall also supply sleeves, supports, anchors, hangers, and other items that are to be included in the work of other trades and provide information for positioning.

Part 2 Products

2.01 Materials

- A. Material and equipment furnished and installed by CONTRACTOR for the permanent Work shall be new, unused, of the best quality of make specified, shall be free from defects of any character, and shall be listed as approved by the UL and/or FM.
- B. Equipment with aluminum buses, aluminum conduits, fittings, supports and conductors are not acceptable.

- C. Outdoor electrical equipment shall be weatherproof, NEMA 4X (stainless steel), unless otherwise indicated.
- D. Unless otherwise specified in other Division 26 sections, the sheet metal surfaces of equipment enclosures shall be coated with a rust resisting primer.
- E. Over the primer, a corrosion resistant baked enamel finish shall be applied. The color shall be ASA No. 49, medium light gray.

Part 3 Execution

3.01 General

- A. CONTRACTOR shall install electrical work in accordance with the codes and standards specified, except where more stringent requirements are indicated or specified, verify that materials and equipment properly fit the installation space with clearances conforming to the codes and standards specified except where greater clearance is indicated.
- B. CONTRACTOR shall perform work as required to correct improper installations, at no additional cost to OWNER.

3.02 Electrical Supervision

- A. In addition to supervision required under the General Conditions, CONTRACTOR shall assign a competent representative to supervise the electrical construction work from beginning to completion and final acceptance.

3.03 Inspection

- A. CONTRACTOR shall inspect each item of material and equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of electrical work.

3.04 Preparation

- A. Prior to installing electrical work, CONTRACTOR shall ensure that installation areas are clean, shall maintain the areas in a broom-clean condition during installation operations, shall clean, condition, and service equipment in accordance with the manufacturer's instructions, approved submittals, and other requirements indicated or specified.

3.05 Workmanship

- A. CONTRACTOR shall employ skilled craftsmen experienced in installation of the types of electrical materials and equipment specified. CONTRACTOR shall use specialized installation tools and equipment as applicable and produce installations free of defects.

3.06 Field Quality Control

- A. Equipment Start-Up:
 - 1. After completion of the installation, all systems and equipment shall be tested by CONTRACTOR in the presence of ENGINEER under actual operating conditions. Tests shall be performed according to manufacturer's recommendations.

2. CONTRACTOR shall include with his bid the services of all required Equipment Manufacturer's field service technicians for a period necessary to complete the work to the satisfaction of ENGINEER and OWNER.
3. This service shall be for the purposes of check-out, initial start-up, certification, and instruction of plant personnel.
4. A written report covering the technician's findings and installation approval shall be submitted to ENGINEER covering all inspections and outlining in detail any deficiencies noted.
5. Specific requirements, if any, for a particular system or piece of equipment are contained in the particular specification sections. CONTRACTOR's responsibility relative to coordinating these services is contained in Section 01 7700, Closeout Procedures.

B. Manufacturer's Supervision and Field Installation Check:

1. Where specified, electrical equipment manufacturer shall furnish the services of an authorized representative especially trained and experienced in the installation of his equipment to:
 - a. Supervise the equipment installation in accordance with the approved submittals and manufacturer's instructions;
 - b. Be present when the equipment is first put into operation;
 - c. Inspect, check, adjust as necessary, and approve the installation;
 - d. Repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable; and,
 - e. Prepare and submit the specified manufacturers' certified report. Include all costs for representative's services in the contract price.

C. Final Operation Tests:

1. CONTRACTOR shall test electrical systems for not less than 168 hours, with no interruptions except for normal maintenance or corrective work. Conform to the approved test plan. Coordinate with final operation test required under Section 40 0500, Process Equipment General Requirements.
 - a. Testing Materials:
 - (1) CONTRACTOR shall furnish labor, instruments, recorders, gages, materials, and power for tests as required.

Testing Methods:

 - (2) CONTRACTOR shall operate systems continuously 24 hours a day under constant inspection of trained operators.

- (3) Cause variable speed equipment to cycle through the applicable speed range at a steady rate or change. Induce simulated alarm and distressed operating conditions, and test controls and protective devices for correct operation.

End of Section

Section 26 0510

Basic Electrical Materials and Methods

Part 1 General

1.01 Scope of Work

- A. Requirements specified in Section 26 0500, Electrical General Requirements, are part of this Section. This section forms a part of all other sections of Division 26, unless otherwise indicated.

1.02 Related Work Specified Elsewhere

- A. Section 03 3000: Cast-in-Place Concrete
- B. Section 26 0500: Electrical General Requirements

1.03 Submittals

- A. CONTRACTOR shall submit for ENGINEER's approval material lists, shop drawings, and factory test reports, to the extent required in this section and Section 26 0500, Electrical General Requirements.

Part 2 Products

2.01 Basic Equipment and Materials

- A. Disconnect Switches:
 - 1. Provide heavy-duty rated disconnect switches of the types and ratings, as indicated on the Plans. Disconnect switches for use on 120 VAC systems shall be rated for 240 VAC. All disconnect switches shall be NEMA 4X stainless steel and provided with a pad-lockable operating handle.
 - 2. Disconnect switches shall be manufactured by Square D Co., Allen Bradley, or Eaton.
- B. Lighting Panels:
 - 1. Lighting panels shall be of code gauge steel, of the dead front safety type with single or multi pole circuit breaker branches of the number and size as indicated on the drawings. Lighting panels shall be NEMA 4X stainless steel. Main bus shall be copper. Each panel shall have a main circuit breaker as indicated on the drawing and have a 10,000 RMS symmetrical interrupting capacity for 240/120 volt panels. Lighting panels shall be square D "NQOB", G.E. NLAB, or Eaton.
- C. Wire Size and Insulation (Low Voltage):
 - 1. Wire for branch circuits, including power and lighting shall consist of No. 12 minimum size copper conductors, type THHN, THW, XHHW or THWN, insulated with Underwriters' approved 600-volt insulation, and in accordance with the following:

2. Rubber and rubber-like insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-19-81 (latest edition), NEMA Publication No. WC3.
3. Thermoplastic insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-61-402 (latest edition), NEMA Publication WC5.
4. Cross-linked polyethylene insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-66-524 (latest edition), NEMA Publication No. WC7.
5. Indoor lighting branch circuits and 120 volt receptacle circuits shall be single conductor solid copper, 600 volt insulation, Type "THW", "THWN", or "XHHW" moisture and heat resistant thermoplastic approved by N.E.C. for operating temperature of 75°C and for installation in wet or dry locations.
6. Type "XHHW" heat resistant wire shall be used for wiring of recessed fixtures, and between fixtures and their adjacent outlets.
7. For 480 volt standard service, single conductor stranded copper cable shall have corona, ozone, heat and moisture resistant cross-linked polyethylene 600 volt insulation, or approved equal, rated to withstand a copper temperature of 90°C. without deterioration. It shall meet applicable ICEA Standards, and be UL labeled XHHW.
8. Wire and cable, including feeders, main and branch circuits, shall be color coded as follows:

208 / 120 Volt		480 / 277 Volt	
Color	Phase	Color	Phase
Black	A	Brown	A
Red	B	Orange	B
Blue	C	Yellow	C
White	Neutral	Gray	Neutral
Green	Ground	Green	Ground

9. Conductors No. 8 and smaller shall have color coded insulation, Conductors No. 6 and larger shall have terminations and conductors in pull boxes taped with colored tape, not less than two inches wide.
10. Wire and cable shall be continuous in the same color code and type to its extreme termination point. The use of different type of insulated wire to the same device or equipment will not be accepted. Manufacturers shall be Anaconda, General Cable, General Electric, Okonite, Triangle, or equal.

D. Control Wiring:

1. Control circuit, single conductor field wire shall be No. 14 AWG, stranded copper with 30-mil thick wall of cross-linked polyethylene or polyvinyl chloride insulation rated to withstand a copper temperature of 90° C. at 600 volts without deterioration. It shall meet applicable ICEA Standards.

2. Multi-conductor control cable shall consist of individual conductors, No. 14 AWG, stranded copper with 30-mil thick wall of insulation rated to withstand a copper temperature of 75° without deterioration. The insulation shall be a 20-mil wall of polyethylene with a 10-mil thick polyvinyl chloride jacket. The individual conductors shall be identified per Paragraph 5.6.3. of ICEA Publication No. S-61402 and shall be cabled together with suitable fillers and binder tape to give the completed cable a substantially circular cross section.
3. An overall sheath of black polyvinyl chloride shall be applied to the cable and shall not be less than the following thickness:

No. of Conductors	Jacket Thickness
2 – 5	0.045"
6 – 14	0.060"
15 and above	0.080"

4. The entire cable shall meet applicable ICEA Standards and tests for thermoplastic insulated cables.
5. Control wires to be identified with vinyl wire markers.

E. Panel Wiring:

1. Panel wiring shall be a minimum 14 AWG-MTW, 60° rated for AC connections.
2. Thermoplastic wire cover shall be rated at 600 volts and be colored red for AC wires; light blue shall be used for DC wires; canary yellow shall be used for wires interconnecting with other control panels or systems which may be energized from alternate power source; green shall be used on all ground wire connections; black wire shall be used for power source and white shall be used for power neutral.
3. Instrument shields shall be connected to a common ground termination in the control panel. Shields shall not be grounded in the field.
4. No splices of either control or instrument wiring shall be permitted outside of termination points.
5. Wires comprising the various control systems for this installation shall be identified at each termination with wire identification tags.
6. Numbered tags shall be of the type manufactured of laminated mylar and be capable of withstanding temperatures to 300°F. without deterioration and discoloration.
7. Each wire number shall be "solid" preprinted and not pieced from single and/or double-digit tags.

F. Shielded Single Pair Cable:

1. For general shielded service, single-pair cables shall consist of two conductors, twisted together, served with a continuous aluminum mylar shield with grounding bleed wire and protected with an insulating jacket.

2. Individual conductors shall consist of a tinned, soft annealed copper conductor, stranded, insulated with a 24-mil thick wall of polyethylene. The twisted pair shall be color coded and sized as follows:

- a. Runs under 400 feet - No. 16 AWG
- b. Over 400 feet - No. 14 AWG

G. Multiple Conductor Shielded Cable:

1. This cable construction shall be an assembly of twisted pairs cabled together and served with an overall aluminum mylar shield with grounding bleed wire, with an extruded jacket of polyvinyl chloride having a thickness as follows:

Cable Size	Jacket
3 and 7 pair	60 mils

2. Portable cords shall consist of flexible, bunch stranded, plain annealed copper conductors with a 600-volt heat and moisture resistant rubber insulation suitable for operation with a 60 degrees Celsius copper temperature. Individual conductors shall be color coded for identification and cabled with suitable high strength fillers to give the completed cable a circular cross section.

H. Conduits and Fittings:

1. Conduits shall be manufactured in conformance with the latest published standards of ANSI, ASTM, and UL and shall be as follows:
2. Rigid and intermediate steel conduit, conduit bends, elbows, couplings, and nipples shall be hot-dipped galvanized. Buried rigid steel conduit shall be plastic coated galvanized steel conduit. Couplings and connectors shall be threaded type.
3. Conduit terminations shall consist of double locknuts and insulated bushing, raintight connectors, or threaded hubs as applicable to maintain the rating of the enclosure to which it is being terminated.
4. Joints in conduits shall be made with standard couplings unless neither conduit can be turned; then, union shall be made with O.Z. Type "SP" split coupling or Erickson couplings. Running threads are not permitted.
5. Conduit expansion fittings shall be O.Z. Type "DX" with bonding jumper, as required.
6. PVC conduit material shall have tensile strength of 7,000 psi at 73.4 degrees Fahrenheit, flexural strength of 11,000 psi, and compressive strength of 8,600 psi.
7. PVC conduit fittings and covers shall be of the same manufacturer as the PVC conduit.
8. Flexible liquid tight conduit shall be provided for connections to vibrating or rotating equipment. Conduit shall be Anaconda Type "UA" for 3/4-inch to 1-1/4 inch and Type "EF" for 1-1/2-inch and larger, flexible conduit, with Appleton STN series fittings, as required.

9. Flexible steel conduit similar to "Greenfield" shall not be permitted.
10. Conduits installed in "hazardous areas" shall be approved for the Hazardous Class Division and Group as required by NEC and identified on the drawings.

I. Pull Boxes:

1. Pull boxes, junction boxes, and cable support boxes of proper size and design shall be provided in accordance with the N.E.C. and as required to facilitate installation of wires. Boxes shall be sized in accordance with the N.E.C. Covers shall be gasketed and held in place with corrosion resistant machine screws. Cable supports for vertical runs shall be provided at code required locations, within pull or junction boxes. Boxes shall be NEMA 12 for inside and NEMA 4 for outside use where exposed to the weather or where otherwise called for on the drawings.
2. Pull boxes located in "hazardous areas" shall be in strict accordance with National Electric Code requirements for the type of area classification and as identified on the drawings.

J. Outlet Boxes:

1. Cast steel outlet boxes shall be used for every outlet and switch where called for on the drawings and as herein specified. All cast boxes shall meet the requirements for galvanized finish specified for steel conduits.
2. All outlet boxes for exposed work shall be of cast steel construction with threaded openings Type "FS" or "FD" unless noted otherwise.
3. Provide temporary caps on boxes similar to Gedney, "Red Caps" during construction.
4. Outlet boxes installed in hazardous areas shall be approved for the Hazardous Class, Division and Group as required by NEC and identified on the drawings.

K. Receptacles:

1. In general, the receptacles shall be duplex convenience grounding type with weathertight gasket and covers and shall be installed in exposed cast metal conduit boxes type FD with mounting ears. This also includes receptacles used for disconnects.
2. Convenience receptacles shall be rated 20 amps with back and side wiring and with exposed metal parts finished to resist corrosion.
3. Special purpose receptacles shall be rated 20 amps, 230 volt, unless otherwise called for on the drawings.
4. Weatherproof duplex receptacles shall have a separate spring type cover for each receptacle mounted on a FS or FD box.
5. Receptacles in wet well, kitchens, bathrooms, and as indicated on the drawings shall be provided with ground fault circuit interrupting breakers.

6. Explosion proof receptacles shall be 20 ampere, 2 wire, 3 pole, 120 volts, Killark KRS-215-220 Appleton Crouse-Hinds or equal. Supply one matching plug each.
- L. Light Switches:
1. Switches shall be "T" rated. Switches, and receptacles shall be specification grade and as called for on the drawings.
 2. Covers shall be stainless steel unless otherwise called for on the drawings.
- M. Switch and Receptacle Plates:
1. Plates for switch, receptacles, telephone, and miscellaneous signal outlets shall be 0.040 inches stainless steel with No. 4 finish in all areas unless otherwise noted.
 2. Cadmium plated steel plates shall be installed in equipment space and process areas.
 3. Grouped devices shall be mounted in a single continuous gang plate.
- N. Lighting Fixtures:
1. CONTRACTOR shall furnish all materials and equipment required to install and place in operation all LED fixtures.
 2. Lighting fixtures shall be complete, including all lamps and/or tubes, ballasts, fuses, support brackets and other parts and devices necessary for complete operation.
 3. The lighting fixtures shall be Lithonia model FEM L48 3000LM IMACD MD MVOLT GZ10 40K 80CRI WLFEND2. Other manufactures may be acceptable if approved by ENGINEER in accordance with the requirements for "substitutes" in the General Conditions.
 4. Lighting fixture supports and conduit connections and fittings shall have corrosion resistant qualities.
 5. Underwriters' labels - all fixtures, signs, etc., shall carry the approval of the Underwriters Laboratories, Inc., and be so labeled.
- O. Lamps:
1. CONTRACTOR shall furnish and install all lamps for all types of lighting fixtures as shown on the schedules and drawings. All fixtures shall be cleaned, and all lamps shall be relamped at the end of the job. See Article 3.05 for adjustment and cleaning.
 2. Led lamp color temperature shall be, 4000°K. The initial light output shall be 3,000 lumens.

P. Ballast:

1. Ballast shall be an integral part of the fixtures as specified on the drawings.
2. Ballasts shall be high power factor, non-PCB, E.T.L. certified and shall carry Certified Ballast Manufacturer's and Underwriters Laboratories' labels.

Q. Motor Starters:

1. 3-Phase Starters:
 - a. Starter for each 3-phase single speed motor shall be on the nonreversing across the line combination magnetic type, minimum size 1 with magnetic circuit breaker and control transformer.
 - b. Circuit breaker shall be externally operated, interlocked to prevent opening the cover when the switch is closed.
 - c. Starter shall have, in addition to a holding circuit contact, two auxiliary contacts.
 - d. Control transformer shall be rated 480 volts to 120 volt with fused secondary, minimum 50 VA but of sufficient capacity to service the starter coil plus such auxiliaries as may be indicated. Each starter shall be provided with wiring and schematic control diagrams which applies to the unit it serves.
2. Single Phase Starters:
 - a. Starters for single phase motors shall be manual type, with overload protection and on-off switch.

R. Nameplates:

1. Safety switches, lighting panels, starter enclosures, panelboards, etc., nameplates shall be of laminated white plastic with black lettering and shall be attached with sheet metal screws. Nameplates size shall be 2-1/2-inch wide x 3/4-inch high. First line character size 1/4-inch high, second line 3/16-inch high. For panel designations, refer to electrical panel schedule on drawings. Panelboards shall contain a typed circuit schedule inside of cover.
2. Field located instruments and devices shall be equipped and identified with 1" x 3" engraved nameplates (similar to the panelboard nameplates) and affixed to their respective devices in a positive but flexible method (wire strap or other similar means).

2.02 Mixes

- A. Patches, conduit sealing compound, fire stop compounds, etc., shall be mixed in accordance with the manufacturer's recommendations.

2.03 Fabrication and Manufacture

- A. CONTRACTOR shall, to the degree possible, preassemble switchgear, panel boards, motor control centers, control panels, relay panels, etc.
 - 1. Preassembly should be done off site in a clean shop environment by CONTRACTOR or manufacturer.
- B. Control panels, motor control centers, and switchgear shall be fabricated in sections not exceeding 10 feet in length and provided with jumpers for field connections of bus and interconnecting wiring.
 - 1. Panels shall be provided with adequate lifting eyes.

2.04 Equipment

- A. Electrical devices furnished under this Contract will be of the most recent manufacture and received at the job site in the manufacturer's shipping container which clearly identifies the item.
- B. Only new electrical equipment will be acceptable. Used, rebuilt, or discontinued models will not be accepted for installation under this Contract.

2.05 Acceptable Manufacturers

- A. Only manufacturers recognized as producing new, top quality products meeting applicable standards will be considered acceptable.
- B. ENGINEER may require CONTRACTOR to furnish acceptable material from other sources of supply, if he finds the Work will be delayed or adversely affected in any way because the stated source of supply cannot furnish a satisfactory product in sufficient quantities or if it is known to be unsuitable for the purpose for which it is proposed to be used. CONTRACTOR shall have no claim for additional compensation because of such requirement.

Part 3 Execution

3.01 Contractor's Verification

- A. General:
 - 1. Dimensions which tie mechanical and/or electrical installations to the building structure shall be thoroughly field checked for accuracy and possibility of interference due to field conditions. Ignorance of such field conditions because of CONTRACTOR's failure to field check the dimensions in question will be no excuse for additional compensation.
- B. Surveys:
 - 1. CONTRACTOR shall lay out and establish the lines and grades of all underground conduits on the site in accordance with the drawings and he shall employ a competent surveyor for this portion of the work.

2. In the event of unforeseen obstructions, CONTRACTOR shall confer with ENGINEER and obtain his written approval before proceeding with any work deviating from the governing drawings. CONTRACTOR shall assume full responsibility for locations and grades throughout this portion of the Work.
- C. Locations:
1. Wall outlets, telephone outlets, clock outlets, specialized outlets, fixtures, and equipment rough-ins shall be field located except as otherwise shown on the drawings.
- D. Points of Termination:
1. The points of connection and termination of related work under this Division of this Project are indicated on the Plans or stated in the Specifications, but in case of doubt as to such points of connection or termination, the decision of ENGINEER shall be final.

3.02 Preparation

- A. Conduit, fittings, and accessories shall be free of foreign matter. Conduit ends shall be reamed and deburred to prevent damage to the wire and cable.

3.03 Installation

- A. General Requirements:
1. Electrical system layouts indicated on the Plans are generally diagrammatic and locations of outlets and equipment are approximate. Exact routing of conduits and wiring, locations of outlets and equipment shall be governed by structural conditions and obstructions. Equipment requiring maintenance shall be located and installed so that it shall be readily accessible.
 2. CONTRACTOR shall not burn, cut or drill structural steel for the installation of conduit in any manner except where written permission is granted by ENGINEER
 3. Wiring shall be installed in raceway, including low voltage work, except where otherwise shown or specified.
 4. Minimum conduit size shall be 3/4-inch unless noted otherwise.
 5. Conduit shall be installed to be concealed wherever possible, unless otherwise indicated. In unfinished mechanical equipment rooms where the exact location of ventilation ducts, etc., is not shown, install the conduit exposed and avoid interferences.
 6. Conduits shall be separated by at least 12 inches from parallel runs of steam or hot water piping.

7. Rigid steel conduit shall be used for exposed service drops in mechanical equipment and process area rooms, in exposed outdoor areas, except where another type of raceway is specified. Locknuts shall be steel or malleable iron (as size requires).
8. Conduit runs in floor slabs and direct buried underground between structures shall be rigid steel. Stub ups shall be rigid steel.
9. Where PVC conduit is permitted as noted on drawings, underground PVC conduit runs shall be installed on approved plastic spacers and encased in a 3-inch Granular Material envelope with red-oxide pigmented concrete over top. Envelopes shall have a yellow-colored, plastic, detectable caution tape buried a minimum of 12-inches above the conduit. Caution tape shall be labeled "Caution – Buried Electrical Lines".
10. Connections to vibrating or rotating equipment shall be made with flexible liquid tight conduit.
11. Provide expansion fittings at all expansion joints and/or where required to compensate for expansion and contraction in long conduit runs. Connectors shall be compatible with flexible conduit used.
12. Conduits shall be installed in floors and walls, wherever possible, unless otherwise indicated on the Plans or specified herein.
13. Empty feeder and riser conduits shall contain one No. 10 AWG galvanized steel pull wire. Splicing of the pull wire will not be permitted.
14. Conduit joints shall be set up tight. Runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical.
15. Multiple conduit runs exposed shall be mounted with rustproofed steel supports arranged so that each conduit is individually clamped or bolted. Steel conduit supports shall be hot-dipped galvanized after fabrication.
16. Concealed conduits or outlets installed flush in masonry or concrete construction shall be rigidly braced against movement during the construction period to ensure accurate termination points.
17. Conduits hidden by suspended ceilings may be run exposed between ceiling construction and structural slab. Conduits, where exposed in service rooms, mechanical equipment rooms, etc., and other work areas, shall be racked in neat symmetrical lines with proper supports. Conduits shall be run at right angles and parallel to floors, ceilings, and walls.
18. Underground conduit shall be tested to determine that all fittings are completely sealed. The tests shall be performed during and after installation of conduit, but before cable is pulled and before any conduit is encased in concrete.
19. Ninety (90) degree bends 1-1/4 inches and larger shall be made with factory elbows. Elbows of 3-inch conduit size and larger shall be long radius. Field bends shall be made so that the conduit will not be injured and the internal diameter shall not be effectively reduced. Factory elbows, nipples, and couplings shall be the same type as the conduit with which they are used.

B. Hazardous Locations:

1. Equipment, fittings, and wiring installed in hazardous areas, shall be approved by the N.E.C. for respective class and division which is applicable to area(s) where installed.
2. Sealing fittings shall be properly installed at all required locations in accordance with code regulations. Automatic drain conduit seals shall be used wherever necessary to ensure the prevention of moisture accumulation. Approved breathers shall be installed in appropriate locations.

C. Conduit Supports:

1. Conduit supports shall be suitably spaced and secured so as to provide adequate mechanical support and shall meet the code requirements. Supports shall be of steel bar, unistrut, angle or channel and of a size to provide a firm, rigid support. Fabricated supports and mounting brackets shall be hot dip galvanized after fabrication and drilling is complete. Rod hangers may be used when laterally braced. Structural steel flanges of I beams or channels shall not be drilled. Prefabricated sections may be used with approval of ENGINEER.
2. Electrical equipment including raceways, outlet boxes, panels, fixtures, etc., shall be substantially secured to the building structure. Inserts or insert bolts for support of the electrical equipment shall be installed during the building construction wherever practical.
3. Exposed multiple horizontal and vertical parallel runs of conduit shall consist of galvanized steel framing channels, conduit clamps, and rod hangers, where required, installed in accordance with the manufacturer's recommendation for the carried loads.
4. Where exposed isolated conduit needs clamping to flat surfaces, clamps shall consist of galvanized malleable iron, one-hole pipe straps for conduit up to and including 1-1/2 inches. Straps for conduits above 1-1/2 inches shall be two-hole, extra heavy steel. Steel bolts of appropriate size to fill the holes of the straps shall be used.
5. Conduit shall be supported in accordance with N.E.C.

D. Conduit Fittings:

1. Conduit fittings shall be made of a compatible material as the conduit. All conduit fittings with blank covers shall have rubber gaskets except in clean, dry areas and shall be accessible after the Work is completed.

E. Sleeves and Inserts:

1. CONTRACTOR shall provide all openings and sleeves on walls and floors as required for his work. Inserts shall be the tapered nut type with lead alloy expansive retainer sleeve. The use of wooden plugs will not be permitted.

F. Lighting:

1. Lighting fixtures shall be mounted level at the height as indicated on the Plans.

G. Taps and Splices:

1. Splices and taps shall be made by means of screw type pressure connectors. Spring pressure type connectors may be used for No. 10 AWG conductors and smaller. Instrument pigtail splices shall be made with solderless crimp type connectors.
2. Connections for No. 8 wire and larger to switches, panels, and controllers shall be made with solderless lugs of proper style and size to handle full wire capacity.
3. Stranded cable terminations shall be equipped with solderless lugs.
4. No splices outside of enclosures will be allowed. No splices except for lighting fixture and instrument pigtail connections shall be permitted unless specifically indicated on the Plans or written approval is given by ENGINEER.
5. Joints not supported and enclosed on terminal strips or equipment lugs shall be insulated with high-quality tape or material in an approved manner.

H. Wiring:

1. Wiring for power, lighting, telephone, sound, and low voltage control shall be run in one of the types of conduit described in these Specifications, unless indicated otherwise on the Plans.
2. Multi-wire branch circuits shall be color coded as stipulated in the National Electrical Code, and as herein specified.
3. Circuits feeding duplicate processing equipment shall be installed in separate conduits.
4. Instrumentation cable shall be run in conduits so as to isolate the cable from power or electrical wiring.
5. Cable insulation shall not be cut back beyond what is reasonably required to make connection, splice, or termination.
6. Wires and cables shall be tagged at both ends and in pull boxes or panel box gutters they pass through.
7. No conductors shall be pulled into any conduit run before all joints are made up tightly and the entire run rigidly secured in place.
8. Approved pulling-in compounds shall be permitted for ease of pulling cables. Pulling of cables shall in no way cause injury to conductors by elongation or to insulation by abrasion, binding, etc. Damaged cable shall be replaced.

I. Foundations:

1. The electrical subcontractor shall arrange with CONTRACTOR to provide concrete pad foundations for all floor-mounted equipment installed under this Division. Pad shall be four inches high, unless noted otherwise.

J. Access Panels:

1. Access panels or hatches shall be provided wherever electrical equipment concealed by the building construction requires access for inspection, operation, or maintenance. CONTRACTOR shall furnish all such panels required for access to his work. CONTRACTOR shall install all panels.
2. A subcontractor requiring access panels shall confer with CONTRACTOR in regard to access panel locations and shall, wherever practicable, group equipment requiring access such that a single panel will serve all and eliminate additional panels.

K. Grounding:

1. CONTRACTOR is responsible for providing all grounding, whether or not shown on the Plans, and all grounding shall be provided in accordance with NEC and local codes and ordinances. Grounding as shown on the plans is the minimum acceptable. Electrical grounding shall be grouped into two (2) classifications as follows: system grounding and equipment grounding.
 - a. System:
 - (1) Use of the metallic conduit or fittings or piping as a grounding path shall not be acceptable.
 - b. Equipment:
 - (1) Metal or conducting type enclosure frames, raceways, cable trays, conduit, panelboards, substation, motor frames, switches, switch boxes, outlet boxes, junction boxes, lighting fixture frames, building steel, metal siding, rebar, piping, etc., shall be grounded by a green colored or bare equipment grounding conductor of size called for in tables of the most recent applicable N.E.C. edition.
 - (2) When a separate equipment grounding conductor is used, it must be contained within the same raceway or cable with the circuit conductors.
 - (3) Grounding rods, hereinafter referred to as ground rods, shall be solid cylindrical rods, 3/4-inch in diameter and 10 feet in length, or longer, as required to reach specified resistance. Rods shall be of copper-clad steel tinned at top end for connection.
 - (4) Resistance from the building ground loop to earth before connection to the building steel and the water system shall not exceed 2 ohms.

- (5) Bare copper bar, cables, or fittings used for grounding shall not be installed in cinder fill or covered with soil containing cinders or other corrosive materials. Cables shall be installed with enough slack to prevent stresses.
- (6) Where ground conductors pass through floor slabs, building walls, etc., and are not encased in rigid metal conduit as specified elsewhere, shall be provided with sleeves of transit, plastic, fiber or other approved nonmetallic material, and of the required size, shape, and length unless otherwise specified or indicated on the Plans.
- (7) Bonding jumpers shall be copper and of a cross-sectional area at least equal to their corresponding grounding conductors. Where attached to equipment, conduits, cabinets, etc., suitable approved solderless lugs, compression connectors or clamps shall be used. No soldered connections shall be used on grounding circuits at any point, except where ground conductors are attached to lead cable sheaths.
- (8) Grounding mediums shall be bonded together. This shall include electric, telephone, antenna systems, ground and underground piping systems which enter the structure.
- (9) Compression connectors, lugs, etc., used in grounding circuits in any location shall have bolts, nuts, etc., of silicone bronze alloy metal. Ground connections, clamps, etc., shall be as manufactured by Burndy Engineering Company, Thomas & Betts Company, Penn-Union Electric Company, or equal.
- (10) The minimum number, spacing, and location of ground rods to be driven shall be per the site soil conditions during dry weather. Connections to ground rods shall be below finished grade level and shall be connected by a "cadweld", or other thermal process.
- (11) Use of the water system as the grounding electrode shall not be acceptable. However, the water system shall be grounded to the grounding system.
- (12) Taps and splices in grounding cables shall be made by the "cadweld", or equal process.
- (13) Conduits which run to boxes or cabinets having concentric or eccentric knockouts which partially perforate the metal around the conduit and impair the electrical connection to ground shall be provided with approved bonding jumpers. Jumpers shall consist of a stranded, braided copper wire at least No. 6 AWG with solderless lug on each end. Jumper shall be connected inside the box to a stud or silicone bronze alloy bolt in the cabinet frame.

- (14) Conduit expansion joints and telescoping sections of metal raceways not thoroughly bonded otherwise shall be provided with approved bonding jumpers of not less than No. 6 AWG stranded bare copper.

L. Electrical Equipment Identification:

1. Electrical devices shall be labeled in a clear and permanent manner to identify its electrical circuit.
2. Motor circuits shall have the functional description on motor starter panel and distribution panelboard doors, remote safety switches and manual switches.
3. Receptacles and wall switches shall be identified using the distribution panel "letter designation" and circuit breaker numerical assignment.
4. Motor starters, switch boards, and panelboards shall have laminated plastic identification nameplates attached to the unit with screws as specified herein. Other electrical devices shall be identified using 1/4-inch plastic adhesive-backed embossed tape securely fastened to the face of the device.

M. Painting and Finishing:

1. Concealed iron work, panel boxes, junction and pull boxes, and support boxes not galvanized shall be given one coat of rust resisting paint inside and out. In addition, junction boxes shall be given one coat of white enamel inside only.
2. Equipment which was finish painted by the manufacturer or fabricator shall remain as is unless paint has become marred or damaged during installation, in which case the equipment shall be repainted to its original condition by CONTRACTOR.

3.04 Field Quality Control

A. Requirements of Regulatory Agencies:

1. Materials and equipment required for the work and the installation shall conform to all national, state, and local codes, rules, regulations, and ordinances. CONTRACTOR shall secure all permits, inspections, and tests required in connection with his portion of the Project.

B. Tests:

1. After the installation of apparatus and wiring has been completed, all electrical conductors shall be tested by CONTRACTOR to ensure continuity, phasing, proper splicing, freedom from unwanted grounds, and insulation values.
2. A 1,000-volt hand-driven megger shall be used on all 600 volt insulated service conductors and a 500-volt hand-driven megger may be used on all lower voltage insulated service conductors. Conductors shall be isolated from other equipment during test and each cable shall be tested until reaching a constant value for 15 seconds.

3. Megger and high potential tests of multiple conductor cables shall be applied between one conductor and ground with all other conductors connected to the same ground. Each conductor shall be tested in like manner.
4. Wiring not measuring up to minimum ICEA field testing standards shall be replaced.
5. Minimum acceptable reading is 100 megohms for 600 volt insulated service conductors and 1.0 megohms for lower voltage insulated services such as instrumentation cables.
6. Tests shall be made with lightning arrestors removed and disconnections made at points of final termination.
7. Motor rotation shall be checked with the motor disconnected mechanically from equipment to be driven, to prevent damage to the equipment. Motor rotation shall be as directed by the equipment manufacturer and shall be checked for accuracy in cooperation with the manufacturer.
8. Do not test the equipment unless it is sufficiently lubricated.
 - a. Tests on Grounding:
 - (1) Inspect ground conductors and connections for conformance with design specifications and for satisfactory workmanship.
 - (2) Test resistance to earth of each ground rod and each ground grid.
 - (3) Test ground paths for equipment and structural steel grounding.
 - b. Maintain each ground rod isolated from the associated ground grid for tests on individual rods for resistance to earth.
 - c. Include associated ground rods and interconnecting wiring in tests on each grid system for resistance to earth.
 - d. Include ground bus on equipment, grid connection, and associated intermediate copper ground conductors in tests on ground paths for electrical equipment.
 - e. Include structural steel connection, grid connection and intermediate conductor in tests on ground paths for structural steel.
 - f. Test each ground rod for resistance to earth by a standard method. Use a Biddle ground tester or the method of using two auxiliary ground rods as described in IEEE Standard No. 550, paragraph 3.42. The IEEE method requires the use of AC test current. Place auxiliary test rods sufficiently far away from the rod under test so that the regions in which their resistance is localized do not overlap. Calculate ground resistance from the readings taken. Maximum acceptable resistance to earth at each ground rod: 25 ohms.

- g. If the resistance is found to be higher than 25 ohms, drive additional rods with a minimum separation of 10 feet and connect in parallel with the rod under test until 25 ohms or less is obtained, or increase the length of the rod under test until 25 ohms maximum is obtained.
 - h. Test each isolated ground grid as specified for individual ground rods, except the maximum acceptable resistance to earth is five ohms. In tests on total ground systems, the maximum acceptable resistance to earth is two ohms.
 - i. Test ground paths for electrical equipment and structural steel for continuity by applying a low voltage DC source of current, capable of furnishing up to 100 amperes. The ground path for electrical equipment using structural steel must conduct 100 amperes. Resistance as calculated from the current and voltage must not exceed 0.010 ohms.
 - j. Grounding materials and connections must pass all inspections and must meet all specified maximum and minimum values.
 - k. Make complete records of all tests. Include resistance values obtained, calculations of same, and methods of test and calculation.
- 9. Notice of tests to be performed shall be sent to ENGINEER and OWNER before tests are made.
 - 10. Duplicate certified records of all insulation tests shall be furnished to ENGINEER.

3.05 Adjustment and Cleaning

A. Adjustments:

- 1. CONTRACTOR shall be responsible for making any equipment and instrument adjustments necessary to provide a complete and safe working system under normal operating conditions.
 - a. Equipment to be adjusted shall include, but not limited to, ground fault circuit interrupters, circuit breaker trip settings, motor starter overload settings, thermostats, pressure switches, level switches, limit switches, control instruments, etc.
 - b. CONTRACTOR shall provide a coordination study of the electrical system.

B. Manufacturer's Services:

- 1. Services of a factory trained, qualified service representative of the equipment manufacturer shall be provided by CONTRACTOR to inspect the complete equipment installation to ensure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation, and instruct the operating personnel in the

proper care and operation of the equipment furnished. This will be required for the main switch gear/motor control center, main control panel including all instrumentation and any other major equipment.

C. Cleaning and Finishing:

1. Before turning the systems over to OWNER, clean all fixtures, equipment, exposed metal surfaces, and leave all in clean condition at the end of the Work as specified elsewhere in the Contract Documents.

D. Final Inspection:

1. Upon completion of the Work, CONTRACTOR shall conduct a complete inspection of all items of Work and make whatever corrections and adjustments are deemed necessary to a well functioning system that will meet with the satisfaction of ENGINEER and OWNER.

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 5713: Temporary Erosion and Sediment Control
- B. Section 01 8900: Site Construction Performance Requirements
- C. Section 31 2313: Subgrade Preparation
- D. Section 31 2316: Structural Excavation and Backfill
- E. 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 5713: Temporary Erosion and Sediment Control
- B. Section 01 8900: Site Construction Performance Requirements
- C. Section 31 2319: Dewatering
- 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 yd² (1 m²) 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.

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.
- B. 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.

- C. Public and private roads used by CONTRACTOR between the source of borrow and the Project shall be maintained by CONTRACTOR, 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 $\pm 3/4$ 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 2319 Dewatering

Part 1 General

1.01 Scope of Work

- A. This Section includes all dewatering work complete with design of dewatering systems, construction and operation of dewatering systems, abandonment of dewatering systems, protection of personnel and structures, environmental protection and restoration.

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 2316: Structural Excavation and Backfill
- D. Section 31 2333: Trenching and Backfilling
- E. Section 03 3000: Cast-In-Place Concrete

1.03 Design of Dewatering Construction

- A. Geotechnical Investigations made in relation to this Project are provided as reference documents. Interpretation of data and reports, performing additional investigations, and obtaining additional data for construction purposes is the responsibility of CONTRACTOR.
- B. CONTRACTOR shall be responsible for the complete design of structures and methods proposed for dewatering the project site, including the implementation of materials, tools and equipment proposed for use in the Work. Temporary wiring associated with the dewatering shall comply with applicable portions of the National Electrical Code.
- C. Provide monitoring wells as necessary to determine the groundwater levels along the alignment and shaft locations.

1.04 Soil Erosion and Sedimentation Control

- A. Dewatering systems design and construction shall conform to the provisions of Part 91 Soil Erosion and Sedimentation Control, of Act 451 "Natural Resources and Environmental Protection Act" PA 451 of 1994; and Section 01 5713, Temporary Erosion and Sediment Control. Where applicable, CONTRACTOR shall obtain and pay for permits and inspections for dewatering construction in accordance with the provisions of PA 451, State of Michigan, 1994, and local government agencies having jurisdiction. No additional claim for compensation shall be allowed because of CONTRACTOR's failure to obtain or pay for such permits and inspections.
- B. 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. The 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. Also, the measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

1.05 Federal, State, and Local Regulations

- A. Dewatering operations shall conform to the requirements of all federal, state, and local agencies having jurisdiction.
- B. Dewatering water discharged to streams, drains or sewers may require permits from federal, state or local agencies having jurisdiction. CONTRACTOR shall comply with all water quality requirements prior to discharging dewatering water. CONTRACTOR shall be responsible for testing and treatment required to meet water quality requirements prior to discharge. No discharges to sanitary sewers will be allowed without prior approval of local agencies with jurisdiction for the sanitary sewers.

1.06 Protection

- A. Take steps necessary, during the Work of this Section, to protect surrounding property and adjacent buildings, private water supplies, roads, drains, sewers, structures and appurtenances. Adequate measures shall be taken to protect such property and construction from the effects of the dewatering operations.

1.07 Submittals

- A. Submit detailed plans indicating proposed type and location of dewatering wells, type and location of collection/conveyance piping, and point of disposal of pumped water. Do not begin any dewatering work until submittals and supporting data have been reviewed by ENGINEER.
- B. Dewatering system shall be designed by a professional with a minimum of seven years documented experience in the installation and design of dewatering systems. Submittal shall be signed and sealed by a registered professional engineer, stating that the proposed dewatering method is adequate to perform the required tasks.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General

- A. Provide electrical power from local utility. Provide stand-by power and any other required auxiliary dewatering equipment to assure continuous dewatering capability. Dewatering, where required, shall be continuous. Dewatering will not be stopped during work stoppage without approval of ENGINEER. Coordinate construction operations to minimize duration and extent of dewatering required.
- B. Dewatering wells are to use properly designed filters to prevent the migration of soil fines into the well.

3.02 Monitoring and Control

- A. During dewatering operations, monitor ground water level with piezometers to ensure the design or specified groundwater elevation is maintained. Install monitoring wells with screens below the excavation level as required. Install wells at minimum 200-foot intervals located between dewatering wells. Provide access to monitoring wells by ENGINEER.

- B. Modify dewatering operation if geotechnical instrumentation or survey measurements indicate movement of structures, sheeting or embankments, or inability to lower groundwater as specified.
- C. Inspect wells and lines on a daily basis to ensure integrity and watertightness. Keep fittings and connections watertight to ensure release of sulfide to atmosphere from groundwater does not occur.

3.03 Existing Drainage Conditions

- A. Prior to beginning any work, verify in the field the location, type and capacity of existing drainage facilities and conditions which will affect the Work of this Section. No allowances shall be made for conditions found during the progress of the dewatering operations because of CONTRACTOR'S failure to verify such conditions.

3.04 Existing Structures and Utilities

- A. CONTRACTOR shall make field verification of all existing structures and utilities at the site of the Work which are scheduled to remain and which may be affected by the Work of this Section. CONTRACTOR shall be responsible for any damage to existing structures and/or utilities caused because of his Work and shall repair such damage at his expense to the satisfaction of ENGINEER or utility owner.

3.05 Drainage of Excavations

- A. CONTRACTOR shall maintain all finished excavation Work free of water during the preparation of the subgrade and until the completion of the Work. No ground or surface water shall be discharged into existing sanitary sewer. No unit of Work shall be constructed under water except as otherwise determined by ENGINEER. Provide and maintain adequate dewatering equipment to remove and dispose of surface or groundwater entering excavations, trenches or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction is complete.
- B. Excavations which extend down to or below the static groundwater elevation shall be dewatered by lowering and maintaining the groundwater level beneath such excavations a distance of not less than 12 inches (300 mm) below the bottom of the excavation. Drainage system methods shall not cause damage to wells or adjacent property. Outlet drainage piping and conduit shall be kept clean and free from sediment. CONTRACTOR shall be held responsible for the condition of all existing pipes, conduits and structures which he may use for drainage.

3.06 Dewatering Sumps and Pump Wells

- A. Sumps and pump wells used as a part of the dewatering system shall be strongly sheathed and braced to protect the construction while in use. Tops of well casings must be covered to prevent animals and debris from entering and shall be 2 to 3 feet (0.6 to 0.9 m) above ground. Sumps and wells, when abandoned, shall be backfilled and compacted to the satisfaction of ENGINEER.

3.07 Drilling

- A. Methods used in drilling wells associated with dewatering systems shall be the responsibility of CONTRACTOR and shall be acceptable to ENGINEER.

- B. Drilling methods shall insure proper placement of well materials and shall not involve displacement of earth formations.
- C. Drilling shall be done with first class equipment of proper type and in good condition, acceptable to ENGINEER.

3.08 Pumping

- A. Equipment for pumping and pumping methods associated with dewatering systems shall be the responsibility of the CONTRACTOR and shall be acceptable to ENGINEER. CONTRACTOR shall construct or furnish adequate discharge piping to conduct and dispose of the water so as to prevent damage to existing structures or property. Pumping equipment shall be first class, acceptable to ENGINEER, of proper type and size for the Work and in good condition. Provide anchors and supports for pumping equipment.

3.09 Filling and Grading

- A. Upon completion of dewatering Work for the Project, abandon and/or fill holes, trenches, ditches and other earth excavations created by the Work of this Section and not scheduled to remain. Do filling, backfilling and grading to restore excavations and earth banks to the lines and levels indicated on the Plans and as determined by ENGINEER. Earth fills shall be compacted to a density equal to that of the surrounding undisturbed earth.

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 1100: Clearing and Grubbing
- D. Section 31 2200: Grading
- E. Section 31 2316: Structural Excavation and Backfill
- F. Section 33 1100: Water Utility Distribution Piping
- G. Section 33 3000: Sanitary Utility Sewerage Piping
- H. Section 33 3400: Sanitary Utility Force Mains
- I. Section 33 4100: Storm Utility Drainage 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/m³); 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/m³) min
 - 2. Cement: 70 lbs/c.y. (40 kg/m³) min
 - 3. Water: Sufficient water to produce desired flowability, 700 lbs/c.y. (415kg/m³) ±
- 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 (500 mm)
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 1123

Aggregate Base Courses

Part 1 General

1.01 Scope of Work

- A. This Section includes aggregate base courses complete with aggregate materials constructed in preparation for paving or aggregate surfacing.

1.02 Related Work Specified Elsewhere

- A. Section 01 8900: Site Construction Performance Requirements
- B. Section 31 2313: Subgrade Preparation
- C. Section 32 1216: Bituminous Paving

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. Finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in ten (10) feet (30 mm per 5 m).

1.05 Test Reports

- A. Testing lab shall provide ENGINEER with two (2) certified copies of the test results of the thickness of the compacted aggregate. Core drilling, testing for thickness and the 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 four (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 3.08 of this Section.

Part 2 Products

2.01 Dense-Graded Aggregate

- A. Dense-graded aggregate gradation shall conform to Series 21 and 22, as specified in MDOT, Section 902.

2.02 Calcium Chloride Additives

- A. 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 all excavation and compacted subgrades or subbases are adequate to receive the new Work. Correct all 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 Improvements

- A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact. Necessary adjustments in line and grade, to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.04 Preparation of Subgrade or Subbase

- A. Subgrade or subbase shall be fine graded to the cross section indicated on the Contract Drawings and shall be thoroughly compacted prior to the placing of the aggregate material.

3.05 Installation - General

- A. Width, thickness, and type of aggregate materials shall be indicated on the Contract Drawings 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.

3.06 Installation of Aggregate Base Course

- A. Aggregate base 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 Contract Drawings.
- B. Depth of any one layer, when compacted, shall not be more than 8 inches (200 mm). If the required compaction cannot be obtained for the full depth of the aggregate course spread, the thickness of each course shall be reduced or, with the approval of ENGINEER, adequate equipment shall be used to compact the aggregate to the required unit weight.
- C. The subgrade or subbase shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade or subbase, the hauling equipment will not be permitted on the subgrade or subbase but shall be operated on the aggregate base course behind the spreader.
- D. Aggregate shall be compacted to at least 98% of maximum unit weight by the use of approved pneumatic-tired compaction equipment or vibratory compactors.
- 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. Motor graders, trimmers or other approved equipment shall be used to shape the aggregate base course and maintain it until the surface course is placed.
- H. When hauling material over the base course, subbase or subgrade, CONTRACTOR shall limit the weight and speed of his equipment to avoid damage to the subgrade, subbase or aggregate base course. If the subgrade, subbase or aggregate base course becomes rutted due to CONTRACTOR's operation, the subgrade, subbase or base course shall be removed and replaced, acceptable to ENGINEER, at CONTRACTOR's expense.
- I. 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.

3.07 Maintenance During Construction

- A. Aggregate base course and 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.

3.08 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.

3.09 Testing

- A. During the course of the Work, 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. 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. Lane width shall be as indicated on the Contract Drawings or as determined by ENGINEER.
 - 1. If 2 lanes are constructed simultaneously, only one test is necessary to represent both lanes.
 - 2. 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 m²) of such areas or fraction thereof.
 - 3. Location of the depth measurement will be at the discretion of ENGINEER.
- C. The maximum unit weight shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D.

3.10 Defective Work

- A. Thickness:
 - 1. Measurements of aggregate base course thickness will be made to the nearest 1/4 inch (5 mm).
 - a. Depths may be 1/2 inch (10 mm) less than the thickness indicated on the Contract Drawings provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.
 - b. 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 Contract Drawings 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.
 - a. 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.

- b. If the tests indicate a moisture content in excess of six (6) percent, the excess over six (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 six (6) percent.

End of Section

Section 32 1216 Bituminous Paving

Part 1 General

1.01 Scope of Work

- A. This Section includes bituminous paving complete with bituminous materials; bituminous mixtures; installation of bituminous base course, bituminous wearing course, and bituminous curbs; construction of bituminous pavement, sidewalks, drive approaches, and tennis courts, cold milling and pulverizing existing pavements.

1.02 Related Work Specified Elsewhere

- A. Section 01 8900: Site Construction Performance Requirements
- B. Section 31 1100: Clearing and Grubbing
- C. Section 31 2313: Subgrade Preparation
- D. Section 32 1123: Aggregate Base Courses

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. MAPA - Michigan Asphalt Paving Association
 - 4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

- A. Following the final rolling, the surface will be tested longitudinally using a 10-foot (3 m) straightedge at locations selected by ENGINEER. Variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the following limits:
 - 1. For Bituminous Base Course Mixtures:
 - a. Multiple Courses:
 - (1) 3/8 inch (9 mm) for top course
 - (2) 3/4 inch (20 mm) for lower courses
 - 2. For Bituminous Surface Course Mixtures:
 - a. Multiple Courses:
 - (1) 1/8 inch (3 mm) for top course
 - (2) 1/4 inch (5 mm) for lower courses
 - b. Single Course: 1/4 inch (5 mm)

- B. Variations in excess of the specified tolerance shall be corrected as determined by ENGINEER.

1.05 Material Reports

- A. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the ASTM Standards referred to in the Specifications.
- B. CONTRACTOR shall provide ENGINEER, or his authorized representative, with the certified batch plant delivery tickets prior to the placing of the materials.
- C. CONTRACTOR shall supply ENGINEER with a certified job mix design for each type of bituminous mixture used on this Project.

1.06 Test Reports

- A. Testing lab shall provide ENGINEER with two (2) certified copies of the test results of the mix design and the thickness of the bituminous paving material. Core drilling, testing for mix design and thickness, and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.07 Environmental Requirements

- A. Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under Article 3.22 of this Section.

Part 2 Products

2.01 Blended Aggregate

- A. The blended aggregate shall conform to ASTM D692, D1073; AASHTO M29, and as specified in MDOT, Sections 501 and 902. Aggregates for bituminous mixtures shall conform to the applicable requirements of Table A: Composition of Bituminous Mixtures and Table B: Mix Design Criteria.

2.02 Mineral Filler

- A. The mineral filler gradation shall conform to AASHTO M17 and to mineral filler, 3MF, as specified in MDOT, Section 902.12.

2.03 Anti-Foaming Agents

- A. The anti-foaming agents shall conform to anti-foaming agents, as specified in MDOT, Section 904.

2.04 Asphalt Binder

- A. Asphalt binder for use in production of bituminous mixtures shall Be Performance Graded Asphalt Binder, PG58-28, per MDOT Section 904, unless otherwise indicated on the Plans.

2.05 Liquid Asphalts

- A. Liquid asphalts for use in pavement construction shall conform to ASTM D2026, D2027, and D2028, AASHTO M81 and M82, and as specified in MDOT, Section 904.

2.06 Emulsified Asphalt (Bond Coat)

- A. Emulsified asphalt for use in pavement construction shall conform to ASTM D244, and as specified in MDOT, Section 904.

2.07 Composition of Mixtures

- A. Bituminous mixtures shall be mixed and placed in accordance with applicable requirements specified in MDOT Section 501, except as otherwise specified in this Section.
- B. Blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.
- C. Aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture proportioned within the master gradation range limits shown in Table A and meeting the uniformity tolerance limits shown in Table C.
- D. Composition limits in Table A are shown in percent by weight, based on the total aggregate, including mineral filler, in the mixture.
- E. Bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT Procedures Manual for Mix Design Processing), shall meet the requirements for stability, flow, voids in mineral aggregate (VMA), air voids, fines/binder ratio, fine aggregate angularity, L.A. Abrasion loss, and soft particles as specified in Table B, Mix Design Criteria.
- F. Mixtures failing to meet the requirements specified in Table B will be rejected and the CONTRACTOR will be required to submit additional samples of bituminous mixtures until a combination of material is found which will produce a mixture meeting the Table B requirements.
- G. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.
- H. After the job-mix formula is established, the aggregate gradation and the asphalt binder content of the bituminous mixture furnished for the Work shall be maintained within the Range 1 uniformity tolerance limits permitted for the job-mix formula as specified in Table C.
 - 1. If two (2) consecutive aggregate gradations on one (1) sieve, or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, CONTRACTOR shall suspend all operations. (Work days will be charged during the down time.)
 - 2. Before resuming any production, CONTRACTOR shall make all necessary alterations to the materials or plant so that the job-mix formula can be maintained within the deviations permitted under Table C.
- I. CONTRACTOR shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant.
 - 1. Feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.

- J. CONTRACTOR has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.
- K. Aggregate gradation tests will be made on aggregate extracted from samples of bituminous mixture taken from the trucks as directed by ENGINEER. As a general guideline, samples will be taken at initial start of production and at other times when tests indicate that the aggregate gradation is fluctuating, truck samples will be taken at a frequency of one (1) sample per 250 Tons (225 metric tons) of mixture, but not more than four (4) samples per day. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one (1) sample per 500 Tons (450 metric tons) of mixture, but no more than two (2) samples per day.
 - 1. Mixtures exceeding the maximum tolerances listed in Range 2 under Table C, or exceeding the maximum limits specified for the master gradation range will be rejected and CONTRACTOR may be required to remove and replace any bituminous pavements which ENGINEER determines were constructed with mixtures in the excess of these tolerances.
 - 2. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans and in the Proposal.

Part 3 Execution

3.01 Excavation

- A. Prior to the installation of any bituminous concrete pavement, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the bituminous pavement to be installed. Correct all defects and deficiencies before proceeding with the Work.

3.02 Subgrade and Base Course Conditions

- A. Prior to the installation of any bituminous pavement, examine the subgrade and base course to ascertain that it is adequate to receive the bituminous concrete pavement 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. Adjustments in line and grade to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.04 Equipment Requirements

- A. General:
 - 1. CONTRACTOR shall furnish sufficient equipment for completing the Work in a timely and efficient manner.
 - 2. Equipment shall be on the job site and ready for normal operation before the placing of material is started.

- a. Equipment shall be in good working order and of sufficient capacity that the operation can be continuous and a rate of production obtained which insures good workmanship, and eliminates overloading of the equipment or frequent interruptions or delays..
- b. Equipment shall be subject to inspections and testing during construction.
- c. Equipment shall conform to the requirements as specified in MDOT, Section 501 and as specified herein.

B. Pavers:

- 1. Paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition, will not be permitted. Paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied shall be screeded by an oscillating or vibrating screed.
- 2. Paver shall at all times produce a uniformly finished surface, free from tearing or other blemishes that would require hand work. Screed shall be adjustable to provide for tilting to secure the proper drag or compressive action necessary to produce the desired surface texture.
- 3. Paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.
- 4. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.
- 5. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. Extensions shall also be equipped with a continuation of the automatically controlled spreading augers. Screed and extensions shall be provided with an approved method of heat distribution.
- 6. Unless specified otherwise, bituminous pavers shall be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control. A manufacturer approved grade referencing attachment, not less than 30 feet (9 m) in length, shall be used for all lower courses and the first lane of the wearing course. After the first lane of the wearing course has been placed, a 10-foot (3 m), or longer, grade referencing attachment may be substituted for constructing subsequent adjacent lanes of wearing course mixture.
- 7. A self-propelled mechanical spreader capable of maintaining the proper width, depth, and slope without causing segregation of the material, may be used for base courses and for surface courses less than eight (8) feet (2.4 m) in width.

8. When surfacing ramps or shoulders, or when the grade of a concrete gutter or other existing installation must be met, the manner of use of the automatic grade reference and slope control devices shall be determined by ENGINEER.
9. Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day, provided this method of operation will produce results meeting the specification requirements.

C. Crushing Equipment:

1. Crushing equipment for pulverizing existing bituminous base course shall be an approved rotary reduction machine having positive depth control adjustments in increments of ½ inch (10 mm) and capable of reducing material which is at least six (6) inches (150 mm) in thickness. The machine shall be of a type designed by the manufacturer specifically for reduction in size of pavement material, in place, and be capable of reducing the pavement material to the specified size. Cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control. The rate of forward speed must be positively controlled in order to ensure consistent size of reduced material. The machine must be equipped with an accurate tachometer which is mounted in full view of the operator. Crushing equipment shall meet the approval of ENGINEER.

D. Cold Milling Machine:

1. Cold Milling machine for removing concrete or bituminous surfaces shall be equipped with automatically controlled and activated cutting drums that are capable of grade reference, transverse slope control, and produce a uniformly textured surface. An approved grade referencing attachment, not less than 30 feet (9 m) in length shall be used. Equipment for removing the concrete or bituminous surface shall be capable of accurately removing the surface, in one or more passes, to the required grade and cross section.

E. Joint Heaters:

1. Joint heaters shall be infrared or other approved heaters, equipped with an automatic ignition and extinguishing system to ensure that the heater operates only when the paver is moving. It shall be of sufficient length and heating capacity to adequately soften the edge of the mat. The heater shall be oriented parallel to the joint edge. The bituminous pavement shall not be heated by a direct open flame.

F. Rollers:

1. Steel-wheel rollers shall weight at least eight (8) Tons (7 metric tons) and shall be self-propelled, vibratory or static, tandem rollers or shall be self-propelled static 3-wheel rollers.
 - a. Steel-wheel rollers shall be free from backlash, faulty steering mechanism, or worn king bolts.
 - b. Steering device shall respond readily and permit the roller to be directed on the alignment desired.
 - c. Rollers shall be equipped with wheel sprinklers and scrapers.

- d. Roller wheels shall be smooth and free from openings or projections which will mark the surface of the pavement.
 2. Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph (.8 km/hr) and shall have provisions to lock in the manufacturer's recommended speed, the vibration per minute, and the amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.
 3. Pneumatic-tired roller shall be of the self-propelled type with a total weight, including ballast, not greater than 30 tons (27 metric tons).
 - a. It shall be equipped with a minimum of seven (7) wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 1/2 inch (10 mm) is obtained.
 - b. Tires shall be smooth and shall be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 pounds per square inch (550 kPa).
 - c. Tire pressures shall not vary by more than five (5) pounds per square inch (35 kPa) between individual tires.
 - d. CONTRACTOR shall furnish a tire gage which shall be available at all times to enable ENGINEER to check the tire pressures.
 - e. CONTRACTOR shall furnish ENGINEER charts or tabulations showing the contact areas and the contact pressures for the full range of tire inflation pressures and tire loadings for the type and size roller used.
 4. Roller shall be equipped with a mechanism capable of reversing the motion of the roller smoothly. Roller shall be equipped with wheel sprinklers and scrapers or mats.
 5. Rollers shall be of sufficient size to compact the bituminous mixture to the required density without tearing, displacing, or cracking the mat.
- G. Chip Spreader:
1. Chip spreader shall be self-propelled and shall be equipped with pneumatic tires.
 2. Spreader shall be equipped with a screen mounted below the metering gage.
 3. Spreader shall be capable of spreading the cover material uniformly at widths of 3 to 12 feet (1 to 3.5 m), or separate spreaders shall be provided for the specific widths required.
 - a. Rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds per square yard (5 to 27 kg/m²).
- H. Bituminous Concrete Curbing Machine:
1. Bituminous concrete curbing machine shall be self-propelled and shall be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on the Plans. It shall be equipped with templates for the cross sections required.

3.05 Preparation of Foundations

- A. For bituminous base course mixtures required to be placed directly on the subgrade, the density, grade and cross section shall meet the approval of ENGINEER at the time of placement of any mixture.
- B. Prior to placing any bituminous mixture, the surface of the existing pavement including joints and cracks shall be thoroughly cleaned of all dirt and debris.
- C. Existing structures within the limits of the new Work shall be adjusted as specified in the Plans, or as directed by ENGINEER.

3.06 Preparation of Aggregate Base

- A. Prior to the placing of any prime coats or any bituminous mixtures, the density, grade and cross section of the aggregate base shall meet the approval of the ENGINEER at the time of placement of any material.
- B. Surfaces that have become too wet or too dry shall be reworked to provide the required density.

3.07 Preparation of Existing Pavement

- A. This Work consists of preparation of the existing concrete road for resurfacing. All broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches shall be removed. All longitudinal and transverse joints and cracks shall be cleaned in accordance with Article 3.14, Joint Cleanout. Butt joints at the end of surfacing sections and at intersections of adjoining streets shall be made in accordance with Article 3.08. Vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.08 Butt Joints

- A. If butt joints are specified on the Plans, or by ENGINEER, the old surface shall be cut back for at least five (5) feet (1.5 m) to a depth of at least 1-inch (25 mm), for the full width of the joint. The vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.09 Edge Trimming

- A. Trimming and truing the edge of an existing bituminous surface shall be performed as required to give a straight, sharp edge at the proper elevations.
- B. The existing base under the bituminous surface shall be left undisturbed.

3.10 Removing Bituminous Surfacing

- A. When removing an existing bituminous pavement, the edges of the area to be removed shall be cut along straight lines, either perpendicular or parallel to the direction of travel, for the full depth of the bituminous surfacing with the cut edge a minimum of 18 inches (450 mm) back from the disturbed edge of pavement.

- B. The cutting of the edges and the breaking up of the bituminous material within the removal area, and the removing and disposing of the unsuitable material are included in the Work of removing bituminous surfacing.

3.11 Removing Bituminous Patches

- A. Where the removal of bituminous patching material is specified on the Plans or as directed by ENGINEER, it shall be saw cut along the edges of the patched area to prevent the tearing of the adjoining pavement surfaces during the removal operation.
- B. Cutting, removing and disposing of bituminous surfacing and unsuitable materials are included in the Work of removing bituminous patches.

3.12 Pulverization and Shaping of Existing Bituminous Base Course

- A. This Work consists of scarifying, pulverizing, milling, crushing, adding new material if required, shaping, rolling, compacting, and proofrolling the crushed base to the proper elevation and slope.
- B. Additional materials required to fill holes and voids shall be furnished at CONTRACTOR's expense. Additional aggregate, if required shall be 20A or 22A aggregate.
- C. The material shall be scarified and uniformly pulverized to a maximum size of two inches (50 mm), in addition, 95 to 100 percent of the material shall have a particle size of 1-1/2 inches (40 mm) or smaller.
- D. The material shall be scarified and uniformly pulverized, in one or more passes, to the depth specified on the Plans or as determined by ENGINEER.
- E. The maximum length or width of roadbed to be scarified and pulverized at any one time shall be as specified on the Plans or as determined by ENGINEER.
- F. The crushed material shall be rough graded to within 3/4 of an inch (20 mm) of the grade called for on the Plans, or as directed by ENGINEER. Additional aggregate shall be placed, if necessary, to attain the required cross sections.
- G. After the material has been balanced, it shall be thoroughly mixed. In restrictive areas, the material to be mixed may be bladed into a windrow to provide working room for the mixer.
- H. The mixed material shall be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by ENGINEER. Excess material shall be removed and disposed of by CONTRACTOR at his expense.
- I. Finished rolling shall be done with a vibratory steel wheel roller.
- J. Aggregate-bituminous pavement mixture shall be compacted to not less than 95 percent of the unit weight obtained by the AASHTO T180 test method. The test shall be made on the aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density shall be maintained until the material has been surfaced.
- K. Prior to the placing of any surface courses, the pulverized material shall be proofrolled. Proofrolling shall be accomplished with an 18,000 pound (82 000 kg) single axle load. Unstable areas shall be removed and backfilled.

3.13 Hand Patching

- A. Where the filling of holes and depressions in the base or the replacing of the patches is specified on the Plans or as directed by ENGINEER, the filler material shall be an approved bituminous mixture.
- B. The mixture selected will be dependent on the depth and size of the patch and the type of mixture and performance grade of the asphalt binder required.
- C. Patches shall be compacted to the required grade by use of a machine vibrator or approved roller.

3.14 Joint Cleanout

- A. Where joint cleanout is specified on the Plans or as directed by ENGINEER, the joint sealants and foreign material shall be removed to a minimum depth of 1-inch (25 mm) by approved mechanical or hand methods.
- B. Removal and disposal of unsuitable materials and the removal and disposal of bituminous surface patches adjacent to joints are included in the Work for joint cleanout.

3.15 Repairing Pavement Joints

- A. Where existing pavement joints and cracks are to be repaired, as specified on the Plans or as directed by ENGINEER, the existing bituminous surface and any loose or spalled concrete around the joints and cracks shall be removed.
- B. Each joint or crack shall be cleaned and shall be filled with an approved mixture and the mixture shall be compacted with a vibratory machine or by an approved method.

3.16 Cold Milling Concrete or Bituminous Pavement

- A. Where cold milling concrete or bituminous pavement is specified, the pavement shall be milled to the shape and cross section as shown on the plans. Immediately after cold milling, the surface shall be cleaned. CONTRACTOR shall remove and dispose of any resulting debris.
- B. When allowed by ENGINEER, milling materials may be used for temporary wedging.
 - 1. Prior to placing pavement, temporary wedging materials shall be removed and disposed of.
 - 2. Wedging with milled materials is incidental to the Project.

3.17 General Bituminous Pavement Installation Requirements

- A. The width, thickness and type of bituminous paving improvement shall be specified on the Plans, indicated in the Proposal or as determined by ENGINEER.
- B. At street intersections, curb drops conforming to the current rules and regulations of Act 8, Michigan PA 1973, as amended, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalks and driveway approaches shall be provided in locations called for on the Plans or as determined by ENGINEER.

- C. Existing improvements, including structures, shall be protected to prevent their surfaces from being discolored during application of bituminous materials.

3.18 Bituminous Prime Coat or Bond Coat

- A. The prepared foundation shall be treated with bituminous material for prime coat or bond coat as specified. A bond coat shall be applied to each layer of bituminous mixture before the succeeding layer is placed.
- B. Bituminous material shall be applied uniformly by means of a pressure distributor, and only in such areas as may be inaccessible to the regular distributor operation shall the bituminous material be applied by means of the hand spraying apparatus of the distributor.
 - 1. Where necessary to accommodate traffic, the surface shall be treated half-width or as recommended by ENGINEER.
 - 2. Foundation shall be free from moisture when the treatment is applied.
 - 3. Under no circumstances shall pools of bituminous material be allowed to remain on the surface.
- C. The amount of prime coat to be applied per square yard shall be 0.05 gal/s.y (250 ml/m²) unless otherwise specified on the Plans or recommended by ENGINEER.
- D. When prime coat is applied, the surface course shall not be placed until the prime coat has been properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.
- E. Prime coat may be omitted or reduced when authorized by ENGINEER.
- F. Bond coat shall be applied at the rate specified by ENGINEER. This rate will be between 0 and 0.10 gallons per square yard (0 to 450 ml/m²) on the bituminous or concrete foundation and between 0 and 0.05 gallons per square yard (0 to 250 ml/m²) between subsequent courses.
- G. Bond coat material shall be applied ahead of the paving operation for a distance of at least 1,500 feet (450 m), depending on traffic conditions, as determined by ENGINEER. The surfacing shall not be placed until the bond coat has cured.

3.19 Transportation of Mixtures

- A. The transportation of the mixtures as specified shall be in accordance with MDOT, Section 501.

3.20 Placing Bituminous Mixtures

- A. Pavers will be required to have an automatically controlled and activated screed and strike-off assembly except when placing mixtures for:
 - 1. Variable width sections;
 - 2. Sections of pavement less than 1,000 feet(300 m) in length;
 - 3. Placing the first course of a base course mixture on an earth grade or on a sand subbase;or,

4. Placing base course mixtures in widths less than eight (8) feet (2.5 m).
- B. Bituminous base course mixtures shall not be placed in lifts exceeding three (3) inches (75 mm), unless otherwise approved by ENGINEER.
 1. Approval to place lifts in excess of three (3) inches (75 mm) will be based on the ability of CONTRACTOR to place and compact the base course to the required cross section and within the specified tolerances.
- C. For lifts of 2-1/2 inches (65 mm) or greater, a berm of shoulder material shall be banked against the outside edge of each layer of mixture placed unless the sequence of operations is such that the edges of the material are adequately confined and supported in some other manner.
 1. The width of material placed shall be twice the height of the bituminous layer being placed but in no case less than a 6-inch (150 mm) width.
- D. When the application rate for a bituminous wearing course exceeds 220 pounds per square yard (120 kg/m²), the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as authorized by ENGINEER.
- E. Bituminous mixture shall be placed by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified.
 1. The mixture shall be dumped into the center of the hopper and care shall be exercised to avoid overloading the paver and spilling the mixture upon the base.
 2. The paver speed shall be adjusted at the discretion of ENGINEER to that speed which, in his opinion, gives the best results for the type of paver being used and which coordinates satisfactorily with the rate of delivery of the mixture to the paver to provide a uniform rate of placing the mixture without intermittent operation of the paver.
- F. When delays result in slowing paving operations such that the temperature of the mat immediately behind the screed falls below 170 degrees Fahrenheit (75 degrees Celsius), paving shall be stopped and a transverse construction joint placed.
- G. Bituminous mixture shall be placed in one (1) or more layers as called for on the Plans or as approved by ENGINEER.
 1. To take out irregularities in the existing road surface, wedging with bituminous mixture shall be done by placing several layers with the paver.
 2. Corrections to the foundation by wedging with bituminous material shall be made by placing, compacting, and allowing the material to cool prior to paving.
- H. Bituminous mixtures shall be placed using two (2) pavers in echelon or one (1) paver equipped with an approved joint heater.
 1. ENGINEER may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees Fahrenheit (75 degrees Celsius) prior to placement of the adjacent course.
- I. Echelon paving will be permitted when allowed by ENGINEER.

- J. Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped sections, and at transverse joints.
 - 1. Edges of the initial mat for all cold joints shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section.
 - 2. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.
- K. Connections with existing surfaces at the beginning and ending of resurfacing sections and at intersections shall be made by feathering out the mix, by constructing a butt joint, or as approved by ENGINEER.
- L. When placing the bituminous mixture in a lane adjoining a previously placed lane, the mixture shall be placed such that it uniformly overlaps the first lane by two (2) to four (4) inches (50 to 100 mm) and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat.
 - 1. Overlapping material shall be bumped, back onto the hot lane so that the roller will compress the excess material into the hot side of the joint.
 - 2. If, in the opinion of ENGINEER, the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness.
 - 3. Excess material shall be discarded; it shall not be spread across the surface course.
- M. If the lanes are being constructed with two (2) or more pavers in echelon, the loss depths of bituminous material from each paver shall match at the longitudinal joints.

3.21 Rolling and Compacting of Bituminous Mixtures

- A. Each layer of bituminous mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 square yards (650 m²) per hour.
- B. Steel 3-wheel rollers may be used for initial compaction immediately following the paver.
- C. The final rolling operation on each layer of bituminous mixture shall be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.
- D. Roller wheels shall be kept properly moistened with water.
- E. Pneumatic-tired rollers shall be operated in a competent manner and shall not mark or rut the surface or displace the pavement edges.
 - 1. Pneumatic-tired roller shall be ballasted to obtain the required ground-contact pressures as directed by ENGINEER.
 - 2. To obtain a uniformly textured mat and the desired pavement density, ENGINEER may recommend CONTRACTOR to raise or lower tire pressures at any time during the rolling operations.
 - 3. Roller operations shall be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface.

4. The number of passes made by the pneumatic-tired roller shall not be less than two (2) round trip passes over each area.
- F. Rolling of the mixture shall begin as soon after placing without undue displacement, picking up the mat, or cracking.
1. Rolling shall start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the drive wheel of the roller.
 2. Alternate trips of the roller shall be of slightly different lengths.
 3. The maximum roller speed shall not exceed the manufacturer's recommended speed for the type of mixture or thickness of layer being placed.
- G. When compacting an adjoining lane, the longitudinal joint shall be rolled first with the roller supported mainly on the cold lane with only three (3) to six (6) inches (75 to 150 mm) of the roller extending onto the freshly placed bituminous material.
- H. Finish rolling shall continue until all roller marks are eliminated.
- I. Pneumatic-tired rollers will not be permitted on wearing courses.
- J. Areas too narrow to be rolled directly by standard 8-Ton (7 metric ton) tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by ENGINEER, and weighting not less than 300 pounds per inch of width (5500 kg/m).
- K. Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at CONTRACTOR's expense.
- L. See Article 3.31 of this Section for compaction test.

3.22 Weather and Seasonal Limitations

- A. Bituminous mixtures shall not be placed nor the prime coat or bond coat applied when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding.
- B. Unless otherwise approved by ENGINEER in writing, minimum mixture temperature limitations at the time of placement, and seasonal limitations for placing bituminous mixtures shall be in accordance with the following:
- C. Seasonal Limitations:
1. Upper Peninsula.....June 1 - Oct 15
 2. Lower Peninsula, north of M-46.....May 15 - Nov 1
 3. Lower Peninsula, south of M-46.....May 5 - Nov 15
- D. Bituminous paving will not be allowed below these minimum temperatures, nor when there is frost on the grade or existing surface.

Mix Temperature Placement Limitations:			
Temperature of Surface being Overlayed °F (°C)	Rate of Application of Bituminous Material, lbs/syd (kg/m ³)		
	< 120 (65)	120 – 200 (65 – 110)	> 200 (110)
35 – 39 (2 – 4)	-	-	329 (165)
70 – 78 (21 – 25)	302 (150)	289 (142)	275 (135)
79 – 86 (26 – 30)	289 (142)	275 (135)	275 (135)
86 and Over	275 (135)	275 (135)	275 (135)

3.23 Heating Bituminous Materials

- A. Bituminous material which requires heating before application shall be heated in such a manner as to insure a uniform temperature throughout the entire mass with efficient and positive control at all times. It shall be heated to a temperature consistent with the type of material used and only to such temperature as will insure the necessary fluidity.
 1. Excessively high temperatures shall be avoided.
 2. A thermometer shall be provided to enable ENGINEER to observe the temperature at any time.
 3. Bituminous material which has been overheated will be rejected.
- B. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.
 1. Heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater.
 2. Asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

3.24 Patching

- A. Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.
- B. The bituminous patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.
- C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight.

An aggregate base material of not less than 12 inches (300 mm) compacted thickness, or a bituminous base of the specified thickness, shall be used. The top of the base shall be 2 to 2-1/2 inches (50 to 65 mm) below the surface of the adjacent pavement. Bituminous patching material shall be placed and compacted.
- D. The surface of the bituminous patch shall be smooth and shall not vary more than 1/4 inch (5 mm) from the crown and grade of the adjacent pavement. Variations over 1/4 inch (5 mm) from the established grade shall be corrected as determined by ENGINEER

3.25 Chip Seal

- A. Seal coating shall consist of 1 or more applications of bituminous material applied to the prepared surface and 1 or more coverings of coarse or fine aggregate applied to the bituminous material.
- B. Asphalt Emulsion shall be HFRS-2M or CRS-2M and aggregate shall be MDOT 29A unless otherwise specified on the plans.
- C. Cover materials used for seal coating shall be sufficiently dry when it comes in contact with bituminous material. The moisture content shall not exceed 3 percent by weight, dry basis. Satisfactory means shall be provided for the protection of the coating materials against excessive moisture by covering stockpiles, by aeration or through manipulation.
- D. The bituminous material specified for surface coat shall be uniformly applied by means of the pressure distributor in the number of applications provided and in the amount per square yard as determined by ENGINEER. Each application of bituminous material shall cure sufficiently to prevent displacement or pickup by traffic or construction equipment before a succeeding application of bituminous material is made.
- E. Following the application of surface coat bituminous material, the cover material shall be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard as specified or as determined by ENGINEER. Truck wheels shall ride on spread cover material and not on bituminous material.
- F. Irregularities or deficiencies in the uniformity of the cover aggregate on the surface shall be corrected by hand spreading and dragging.
- G. Following the spreading of each course of cover material, the surface shall be rolled by means of approved rollers.
- H. Rolling shall immediately follow the placing of cover material before the bituminous material has set. At no time shall there be more than 300 feet (90 m) of unrolled cover material. No cover material shall be left unrolled for more than five (5) minutes.
- I. Sufficient rolling shall be done to embed the cover material in the bituminous material without crushing the aggregate.
- J. For areas deficient in cover material after completion of the surface treatment, additional cover material shall be added. For areas with excessive cover material, the excess cover material shall be removed before the next seal is applied. Final application of cover material shall be swept with a power broom.
- K. Completed surface shall be maintained with a drag, broom or other approved equipment to keep the material well distributed on the road until all cover material possible has been embedded in the bituminous material. The length of time required for this maintenance will be from 2 to 5 days, as determined by ENGINEER, depending on the weather and the materials used.

3.26 Bituminous Concrete Curb

- A. Bituminous concrete curb shall be constructed to the design specified on the Plans or as approved by ENGINEER and shall include the conditioning and treating of the surface on which the curb is to be placed.

- B. Materials used in the construction and installation of bituminous concrete curbing shall meet the requirements as specified in Part 2, Products of this Section, and as specified in MDOT, Section 904.
- C. Bituminous concrete curb mixture shall be 13 or 13A as specified in this Section and in accordance with MDOT, Section 501, unless otherwise approved by ENGINEER.
- D. Bituminous curb shall be constructed to conform to the Plans or as determined by ENGINEER. The method of construction shall conform to MDOT, Section 805, unless otherwise specified.
- E. Bituminous mixture shall be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by ENGINEER. The curb shall be formed to the density to produce a tight surface texture. Curbs showing segregation, slumping, or misalignment shall be removed and replaced at CONTRACTOR's expense.
- F. When specified on the Plans or as directed by ENGINEER, an application of asphalt emulsion or other approved bituminous coating shall be applied to the finished curb at the joint of the curb and pavement, or to the inside face of the curb, or to both, as a protective seal.
- G. Backfilling behind the curb shall not commence until the bituminous mixture has cured.
- H. Backfill material shall be placed and thoroughly tamped and compacted to the satisfaction of ENGINEER, without disturbing the curb, and shall be left in a neat and workmanlike condition.

3.27 Bituminous Approaches, Sidewalks, and Shoulders

- A. This Work shall consist of constructing a bituminous surface course as specified on the Plans, or as approved by ENGINEER. Bituminous surface course shall be placed on a prepared foundation.
- B. Bituminous materials used shall be as specified on the Plans, or as approved by ENGINEER. Materials acceptable for use are specified in Part 2 of this Section, and as specified in MDOT, Section 904.
- C. Bituminous approach mixture shall be in accordance with MDOT, Section 501, unless otherwise approved by ENGINEER.
- D. Existing pavement or aggregate base shall be prepared to receive the bituminous surface course as specified in this Section.
- E. Bituminous prime and bond coats used shall meet the requirements specified in this Section. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces. When approved by ENGINEER, the prime coat may be omitted.
- F. The bituminous mixture shall be placed to the thickness specified on the Plans or as determined by ENGINEER.
- G. Placing the bituminous mixture shall conform to this Section.

- H. When approved by ENGINEER, the paver used for placing bituminous approaches and sidewalks will not be required to have an automatically controlled or activated screed or strike-off assembly or the corresponding grade referencing equipment. Also, with approval from ENGINEER, only one (1) roller may be used with each paver.

3.28 Tennis Courts

- A. Bituminous tennis courts shall be constructed to the cross section shown on the Plans, or as determined by ENGINEER.
- B. Materials used in the construction of the bituminous tennis court shall meet the requirements specified in Part 2 of this Section, and as specified in MDOT, Section 904.
- C. Bituminous base course mixture shall be 13 or 11A as specified in this Section and MDOT, Section 501 unless otherwise specified on the plans.
- D. Bituminous surface course mixture shall be 4C, 13A or 36A as specified in this Section and MDOT Section 502, unless otherwise specified on the plans.
- E. Asphalt content and performance grade shall be determined by the job mix formula submitted by the CONTRACTOR and approved by ENGINEER.
- F. Bituminous base course and wearing course shall be constructed to conform to the Plan. The method of construction shall conform to MDOT Section 502, unless otherwise specified.
- G. Bituminous bond coat used shall meet the requirements specified in this Section.
- H. The rate of application shall be 0.05 - 0.10 gallons per square yard (225 to 450 ml/m²).
- I. For the preparation of the foundation to receive the bituminous base course and bituminous surface course, see the appropriate Articles in Part 3 of this Section.
- J. Bituminous base course, if required, and the bituminous surface course shall be installed to thickness shown on the Plans. The method of installation of mixtures shall conform to this Section.

3.29 Cleanup

- A. Area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.
- B. Backfill shall be compacted, leveled and left in a neat, workmanlike condition. At a seasonally correct time 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.

3.30 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 furnished and installed by CONTRACTOR and shall be East Jordan Iron Works No. 1570, or approved equal.

4. Density checks will be made at the discretion of ENGINEER to determine if the compactive procedure being used is achieving the required density, or if a change in procedure is necessary.
5. Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

3.32 Price Adjustments

- A. Samples of asphalt binder may be taken prior to incorporation into the mixture and from the bituminous mixture. Where results of tests on these samples deviate from specification requirements, the affected material will be subject to price adjustments on the following basis:
 1. When the test results deviate from the limits specified in MDOT, Table 904-1, Performance Graded Asphalt Binder Specification, by ten (10) percent or more, the mixture produced will be evaluated by ENGINEER and if in his judgment the defective pavement warrants removal, CONTRACTOR shall remove and replace the affected area at his expense. If it is determined that the removal is not required, the Contract unit price of the affected mixture will be reduced by ten (10) percent.
 2. Core samples may be taken on the completed Work. If the results from testing of the core samples indicates a deficiency in the completed Work, ENGINEER will evaluate the test results and will recommend removal and replacement or a credit to OWNER.

See Next Page

Table A: Composition of Mixtures										
Mixture No.	2B	2C	3B	3C	4B	4C	13	13A	11A	36A
Binder %	4-6	4-6	4.5-7	4.5-7	5-8	5-8	5-8	5-8	4-6	5.5-8
Percent Passing Indicated Sieve										
1-1/2" (37.5 mm)	100	100							100	
1" (25 mm)	99-100	99-100	100	100					90-100	
3/4" (19 mm)	90 max	90 max	99-100	99-100	100	100	100	100	70-95	
1/2" (12.5 mm)	78 max	78 max	90 max	90 max	99-100	99-100	75-95	75-95	55-85	100
3/8" (9.5 mm)	70 max	70 max	77 max	77 max	90 max	90 max	60-90	60-90	40-80	92-100
No. 4 (4.75 mm)	52 max	52 max	57 max	57 max	67 max	67 max	45-80	45-80	25-65	65-90
No. 8 (2.36 mm)	15-40	15-40	15-45	15-45	15-52	15-52	30-65	30-65	15-50	55-75
No. 16 (1.18 mm)	30 max	30 max	33 max	33 max	37 max	37 max	20-50	20-50	10-40	
No. 30 (600 um)	22 max	22 max	25 max	25 max	27 max	27 max	15-40	15-40	7-32	50-20
No. 50 (300 um)	17 max	17 max	19 max	19 max	20 max	20 max	10-25	10-25	5-20	
No. 100 (150 um)	15 max	15 max	15 max	15 max	15 max	15 max	5-15	5-15	4-12	
No. 200 (75 um)	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-10
Crushed Min. %	50	90	50	90	50	90	0	25	25	60

Table B: Mix Design Criteria

Mixture No.	2B	2C	3B	3C	4B	4C	13	13A	11A	36A
VMA Min. %	13.5	13.5	15	15	16	16	15.5	15.5	13.5	16.5
Air Voids % Target (1)	3	3	3.5	3.5	3.5	3.5	3	3	3	3
Fines/Binder Ratio Max. (2)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Fine Aggregate Angularity Min. (3)	3	4	3	4	3	4	2	2.5	2.5	3
Flow-in. (mm)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)
L.A. Abrasion Max. % loss (4)	40	40	40	40	40	40	40	40	50	40
Soft Particle Max. % (5)	12	12	12	12	8	8	8	8	12	8
Stability Min. Pounds (kN)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	900 (4.0)	900 (4.0)	900 (4.0)	900 (4.0)

Notes:

- (1) The JMF target may be adjusted in the field, prior to placement, to meet the project design criteria for a specific application; for example, 2.0 percent air voids on shoulders or bike paths.
- (2) Fines/Binder Ratio. The ratio of aggregate material finer than the No. 200 (75 um) sieve to asphalt binder content by weight including fines and bituminous contributed by reclaimed asphalt pavement (RAP).
- (3) The fine aggregate angularity of blended aggregate, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by virgin material.
- (4) Los Angeles abrasion loss must be met for the composite mixture; however, each individual aggregate must be less than 50.
- (5) The sum of the shale, siltstone, structurally weak, and clay-ironstone particles shall not exceed 8.0 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone shall not exceed 12 percent for base and leveling courses.

Table C: Uniformity Tolerance Limits For Bituminous Mixtures						
Type of Course	Range (a)	Percentage Passing Designated Sieves				Asphalt Binder Content
		(b)	No. 8 2.35 mm	No. 30 600 um	No. 200 75 um	
Top and Leveling Course	Range 1	± 5.0	± 5.0	± 4.0	± 1.0	± 0.40
	Range 2	± 8.0	± 8.0	± 6.0	± 2.0	± 0.50
Base Courses	Range 1	± 7.0	± 7.0	± 6.0	± 2.0	± 0.40
	Range 2	± 9.0	± 9.0	± 9.0	± 3.0	± 0.50
Notes: (1) This range allows for normal mixture and testing variations. The mixture shall be proportioned to test as closely as possible to the Job Mix Formula. (2) This includes all sieve sizes No. 4 (4.75 mm) and larger listed on the Job Mix Formula.						

Table A ¹ : Composition of Mixtures									
Total Percent Passing Indicated Sieve (a)									
Mixture No.	No. 1800 No. 1500 No. 1300 (36A)(36B)	No. 1800 No. 1500 No. 1300 (20AAA)	No. 1100 (36A) (36B)	NO. 1100 (20AA)	NO. 1100 (20A)	No. 900 (20AA)	No. 900 (20A)	No. 900 (20B)	No. 700 No. 500 (20C)
1-1/2" (37.5 mm)	-	-	-	-	-	-	-	-	100
1" (25 mm)	-	-	-	-	-	-	-	-	80-100
3/4" (19 mm)	-	100	-	100	100	100	100	100	-
1/2" (12.5 mm)	100	90- 00	100	90-100	-	90-100	-	-	-
3/8" (9.5 mm)	92-100	65- 5	92-100	65-95	60-90	65-95	60-90	60-95	55-90
No. 4 (4.75 mm)	65-90	55- 5	65-90	-	-	-	-	-	-
No. 8 (2.36 mm)	55-75	45- 0	55-75	45-70	40-65	45-70	40-65	40-70	30-55
No. 30 (600 um)	25-50	20- 5	25-50	20-45	20-40	20-45	20-40	20-45	15-40
No. 200 (75 um)(b)	4 -10	3-0	4-10	3-10	3-10	3-10	3-10	3-10	3-10
Binder % (c)	5-9	5- 9	5-9	5-7	5-7	5-7	5-8	5-8	3-6
Crushed Min. %	(d)	60	(d)	40	25	40	25	-	-
Notes: (a) Composition limits are shown in percent by weight, based on the total aggregate, including mineral filler in the mixture. (b) The Job-Mix-Formula shall have a minimum total percent passing a No. 200 sieve of 5.0 percent. (c) The percent of bitumen in the mixture shown in Table A1 is a range and the actual bitumen content in the production mixture shall be as determined by the Job-Mix-Formula. For mixtures No. 900, 1100, 1300, 1500, and 1800 placed in two courses, the leveling course will be designed to have up to 0.5 percent less bitumen than the optimum specified for the top course. Mixtures No. 500 and 700 will be designed to have a target air void of 4.0 percent. (d) 36A = 60%, 36B = 40%									

Table B ¹ : Mix Design Criteria					
Mixture No.	Aggregate Required	Stability Pounds (Minimum)	Flow (.00 inch)	VMA % (Minimum)	Air Voids % Target
500	20jC	500	-	13.0	4.0
700	20C	700	8-16	13.0	4.0
900	20B, 20A, 20AA	900	8-16	13.5	2.5
1100	20A, 20AA, 36A, 36B	1100	8-16	13.5	3.0
1300	20AAA, 36A, 36B	1300	8-16	14.0	3.0
1500	20AAA, 36A, 36B	1500	8-16	14.0	3.0
1800	20AAA, 36A, 36B	1800	9-16	14.0	3.0

End of Section

Section 32 1315 Sidewalks and Driveways

Part 1 General

1.01 Scope of Work

- A. This Section includes sidewalks, sidewalk ramps, driveways, and drive approaches complete with concrete materials, concrete curing compounds, joint materials, field quality control and appurtenances.

1.02 Related Work Specified Elsewhere

- A. Section 01 2200: Unit Prices
- B. Section 31 1100: Clearing and Grubbing
- C. Section 31 2313: Subgrade Preparation
- D. Section 32 9219: Seeding
- E. Section 32 9223: Sodding

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 Highway and Transportation Officials
 - 3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Submittals

- A. Written permission for the use of all local disposal sites shall be obtained and copies shall be furnished to ENGINEER.
- B. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the ASTM Standards referred to in the Specification.

1.05 Test Reports

- A. ENGINEER shall be provided with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. 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 Environmental Requirements

- A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Article 3.11 of this Section.

1.07 Protection

- A. Comply with the requirements for protecting new Work against damage from rain, as specified under Article 3.11 of this Section.
- B. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Article 3.11 of this Section.

Part 2 Products

2.01 Concrete

- A. Concrete shall be in accordance with MDOT Section 601 or 701, use Grade P1 or S2, 3,500 psi (24 MPa) strength; Type IA cement; 6.0 sacks cement per cubic yard (335 kg/m³); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's approval. Type IIIA cement may be used for high-early strength concrete.

2.02 Ready-Mixed Concrete

- A. Ready-mixed concrete shall conform to ASTM C94, Alternate 2.

2.03 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. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without test. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T26, and as specified in MDOT Section 911.

2.04 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.

2.05 Premolded Joint Filler

- A. Fiber joint filler for expansion joints shall conform to ASTM D1751. Filler shall be of the thickness, as specified herein, or on the Plans, or as approved by NGINEER.

2.06 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.

2.07 Joint Sealant

- A. Hot-poured type joint sealant shall conform to ASTM D6690 Type II and as specified in MDOT Section 914.

2.08 Concrete Mix

- A. Concrete shall contain a minimum of six sacks, 94 pounds per sack, of cement per cubic yard (335 kg/m³) and shall yield a minimum compressive strength of 3,500 psi (24 MPa) at 28 days.

- B. Cement shall be air-entraining Portland cement ASTM C150, Type 1A. If high-early strength concrete is desired, Type IIIA is required.
- C. High-early concrete can be obtained for small areas by the addition of one sack of cement, Type 1A, per cubic yard of concrete (56 kg/m³).
- D. The air content of the concrete shall be 6.5%± 1.5% by volume.
- E. Maximum slump of the concrete shall be three (3) inches (75 mm).
- F. Ready-mixed concrete in accordance with ASTM C94, Alternate 2, shall be used, unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by ENGINEER.

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 proper grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades are adequate to receive the concrete to be installed.
- B. Correct all defects and deficiencies before proceeding with the Work.

3.02 Existing Improvements

- A. Investigate and verify location of existing improvements to which the new Work is to be connected.
- B. Adjustments in line and grade to align the new Work with the existing improvements must be approved by ENGINEER, prior to any change.

3.03 Forming

- A. Forms shall be of wood or metal, straight and free from warp, clean, and of sufficient strength to resist springing during the process of depositing concrete against them.
- B. Forms shall be the full depth of the concrete.

3.04 Sidewalks, Sidewalk Ramps, Driveways, and Driveway Approaches

- A. Unless otherwise noted in the Contract Documents, all sidewalks and sidewalk ramps shall be four (4) inches (100 mm) thick except at driveways, where the thickness of the sidewalks shall be six (6) inches (150 mm).
- B. Sidewalks shall be five (5) feet (1.5 m) wide unless otherwise noted on Plans, and shall slope 1/4 inch per foot (20 mm/m) towards the surface drainage side which in general will be towards the center of the road.
- C. Normally sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1-foot (300 mm) from the property line.
- D. Driveways and approaches shall be six (6) inches (150 mm) thick. The width of driveways and driveway approaches shall be as specified on the Plans or as determined by ENGINEER.

3.05 Remove Curb for Curb Drop

- A. Construction of sidewalk ramps within street intersections where curbed pavement exists shall conform to the current rules and regulations of Act 8, Michigan PA 1973.
- B. Where there is no proper curb drop for the sidewalk ramp or driveway approach, CONTRACTOR shall saw cut, to full depth of pavement, and remove a minimum of an 18-inch (450 mm) wide curb and gutter section. When mountable curbs are present, CONTRACTOR shall remove a 24-inch (600 mm) wide curb and gutter section for the construction of sidewalk ramp, as specified above.
- C. Length of curb and gutter removal shall be determined by ENGINEER in the field but shall be at least as wide as the proposed sidewalk ramp plus 1-foot (300 mm) on each side.
- D. Removed curb and gutter section shall be replaced with material, equal to what was removed and the joint sealed with hot poured rubber asphalt.
- E. CONTRACTOR shall install 5/8 inch (15 mm) diameter self tapping hook bolts, in the existing concrete pavement as indicated on the Plans prior to placing concrete for the removed curb and gutter section.
- F. Curbs may be cut or ground down with an approved concrete grinder when the final results will leave the cut or ground down curb in a smooth, clean condition acceptable to ENGINEER. Curbs that are cut or ground down that are not acceptable to ENGINEER, shall be removed and replaced as specified above at no additional cost.

3.06 Placement of Forms

- A. Wood forms, straight and free from warp, of nominal depth may be used for sidewalk sections less than 25 feet (7.5 m) in length.
- B. Forms shall be staked to line and grade in a manner that will prevent deflection and settlement.
- C. When unit slab areas are to be poured, slab division forms shall be so placed that the slab division joints will be straight and continuous.
- D. Forms shall be set for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. The grade shall be uniform, except as may be necessary to eliminate short grade changes.
- E. Forms shall be oiled before placing concrete. Forms shall remain in place at least 12 hours after the concrete is placed. There shall be sufficient forms placed ahead of the pouring operations to maintain uninterrupted placement of concrete.
- F. The use of slip form pavers can be allowed when approved by ENGINEER in lieu of the construction system described above.

3.07 Joints

- A. Transverse and longitudinal expansion and plane-of- weakness joints shall be constructed at the locations specified herein, or as indicated on the Plans or as approved by ENGINEER.

- B. Transverse expansion joints shall be placed for the full width and depth of the new Work. The transverse expansion joints placed against any existing pavement shall be a minimum of 6 inches (150 mm) deep but no less than the thickness of the concrete being placed.
- C. Longitudinal expansion joints shall conform to the same requirements as transverse expansion joints.
- D. Joints shall be constructed true to line with their faces perpendicular to the surface of the sidewalk. The top shall be slightly below the finished surface of the sidewalk. Transverse joints shall be constructed at right angles to the centerline of the sidewalk and longitudinal joints shall be constructed parallel to the centerline or as determined by ENGINEER.
- E. Unless otherwise specified on the Plans or unless otherwise determined by ENGINEER, when the sidewalk is constructed in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with like joints in the adjacent slab. Also, in the case of widening existing sidewalks, transverse joints shall be placed in line with like joint in the existing sidewalk.
- F. Transverse expansion joints, 1/2 inch (10 mm) thick, shall be placed through the sidewalk at uniform intervals of not more than 50 feet (15 m) and elsewhere as shown on the Plans, or as determined by ENGINEER.
- G. Expansion joints, 1/2 inch (10 mm) thick, shall also be placed between the sidewalk and back of abutting parallel curb, buildings or other rigid structures, concrete driveways and driveway approaches. The expansion joint between sidewalks and buildings shall be placed 1-foot from the property line and parallel to it.
- H. Expansion joints, 1-inch (25 mm) thick, shall be placed between sidewalk ramps or driveway approaches and the back of curbs.
- I. Plane-of-weakness joints shall be formed every 5 feet (1.5 m) and shall be produced by use of slab divisions forms extending to the full depth of the concrete or by cutting joints in the concrete, after floating, to a depth equal to 1/4 the thickness of the sidewalk. Cut joints shall not be less than 1/8 inch (3 mm) nor more than 1/4 inch (5 mm) in width and shall be finished smooth and shall be at right angles to the centerline of the sidewalk.

3.08 Placing and Finishing Concrete

- A. Concrete shall be placed on a prepared unfrozen, smooth, leveled, rolled and properly compacted base as indicated on the Plans. The surface of the subbase shall be moist with no visible water present prior to placement of the concrete.
- B. Concrete shall be deposited, in a single layer, to the depth specified in the Plans or in the Proposal. Concrete shall be thoroughly spaded or vibrated and compacted to fill in all the voids along the forms and joints. Concrete shall be struck off with a strike board until all voids are removed and the surface has the required grade and cross section as indicated on the Plans.
- C. The surface of the concrete shall be floated just enough to produce a smooth surface free from irregularities. All edges and joints shall be rounded with an edger having a 1/4 inch (5 mm) radius. The surface of sidewalks, driveways and approaches shall be broomed to slightly roughen the surface.

- D. The surface of sidewalk ramps shall be textured with a coarse broom transversely to the ramp slope. The texture on sidewalk ramps shall be coarser than the remainder of the sidewalk.

3.09 Curing

- A. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the concrete (and sides if slip-forming is used) shall be completely coated and sealed with a uniform layer of white membrane curing compound.
- B. The curing compound shall not be thinned. The curing compound shall be applied at the rate of 1-gallon per 200 square feet (4 L per 20 m²) of surface.

3.10 Barricades

- A. Suitable barricades and lights shall be placed around all newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter section in order to protect the new Work from damage from pedestrians, vehicles and others until the concrete has hardened.
- B. Barricades shall be left in place for a minimum of two (2) days, except for driveway approaches and curb and gutter section. Barricades shall remain in place for a minimum of three (3) days.
- C. Concrete that suffers surface or structural damage shall be removed and replaced by CONTRACTOR at his expense.

3.11 Protection

- A. CONTRACTOR shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened. For this Work CONTRACTOR shall have available on the job site at all times enough burlap or 6-mil thick polyethylene film to cover and protect one (1) day's work. When rain appears eminent, 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. Curing compound shall be applied to any areas where the compound has been disturbed or washed away.
- B. If concrete is placed between October 15 and May 15, CONTRACTOR shall have available on the site sufficient amount of clean, dry straw or hay to cover one day's production. If the temperature reaches 40 degrees Fahrenheit (4 degrees Celsius) and is falling, the hay or straw shall be placed 12 inches (305 mm) thick, immediately after the curing compound is applied. If the temperature is 30 degrees Fahrenheit (-1 degrees Celsius) and falling the curing shall be by 6-mil thick polyurethane film placed on the concrete as soon as the surface moisture has disappeared, and then covered with 12 inches (300 mm) of straw or hay.
- C. Also, whenever the temperature in the shade falls below 50 degrees Fahrenheit (10 degrees Celsius), the water, sand and coarse aggregate shall be heated in that order sufficiently to maintain a uniform temperature of the concrete at between 70 degrees Fahrenheit and 80 degrees Fahrenheit (21 to 27 degrees Celsius).
- D. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit (32 degrees Celsius).

3.12 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. Backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- B. 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 32 9223, Sodding.

3.13 Testing

- A. ENGINEER may require that a minimum of two cores be drilled from the sidewalk for each 500 (or fraction thereof) linear foot (150 m) section placed. At least one (1) core out of two (2) required will be taken from the sidewalk at the driveway. One (1) core may be required from every 20 (or fraction thereof) of driveway approaches or sidewalk ramps installed.
- B. Cores shall be checked for depth and compressive strength. Core drilling and tests shall be done by a testing laboratory designated by OWNER and at the expense of OWNER. The testing laboratory shall furnish ENGINEER with two (2) certified copies of the test results.
- C. In the event the test results on a core indicates a deficiency in either thickness or compressive strength the following adjustments in the unit price for concrete shall be made:

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 1/2"	20
by more than a 1/2", but not exceeding 1"	50
by more than 1"	Remove & Replace

Compressive Strength	
Under Required Compressive Strength	Percent of Reduction in Unit Price
0 to 150 psi	None
by more than 150 psi, but not exceeding 300 psi	20
by more than 300 psi, but not exceeding 500 psi	50
by more than 500 psi	Remove & Replace

- D. The area of the 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. Extra core drilling and testing shall be at the expense of CONTRACTOR. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch (9 mm) and under strength by 200 psi (1.3 MPa), the total reduction is 20% plus 20% or 40% reduction.

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 8900: Site Construction Preparation Requirements
- B. 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 (P₂O₅) and total available Potash (K₂O) 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: Small grain straw or grass or marsh hay acceptable to ENGINEER.
- B. Wood Excelsior:
- Green wood fibers, baled or blanket of type; manufacture acceptable to ENGINEER.
 - Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.
 - 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 $\pm$ 1-inch (900m m $\pm$ 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) $\pm$ 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:
- | | | |
|-----|-----------------------------|------------------------------|
| 1. | Quality Parameter..... | Range of Value |
| 2. | Soil pH..... | 6 to 7.5 |
| 3. | Soluble Salts..... | 2 to 5 mmho/cm |
| 4. | Carbon/Nitrogen Ratio..... | 13 to 20 parts C to 1 part N |
| 5. | Inerts..... | < 1% |
| 6. | Organic Matter..... | 35 to 55 % |
| 7. | Nitrogen..... | 1 to 2 % |
| 8. | Phosphorus..... | 0.2 to 0.8 % |
| 9. | Potassium..... | 0.5 to 1.5 % |
| 10. | Unit Weight..... | 535 to 775 Kg/m3 |
| 11. | Moisture Content..... | 40 to 50 % |
| 12. | Particle Size..... | < 20 mm maximum |
| 13. | Water Holding Capacity..... | > 100% |
| 14. | 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, $\pm$ 1-inch (100 mm $\pm$ 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/m²). 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/m²). 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 cm²) 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 0130.16

Television Inspection of Sewer Utilities

Part 1 General

1.01 Scope of Work

- A. Section includes internal television (TV) inspection of sewer utilities using color closed-circuit television (CCTV) camera, and document inspection on video for the purpose of locating and observing the condition and possible extraneous connections.

1.02 Related Work Specified Elsewhere

- A. Section 33 0130.53: Cleaning of Sewer Utilities
- B. Section 33 0132: Geopolymer Lining System

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. NASSCO - National Association of Sewer Service Companies

1.04 Submittals

- A. Work Schedule:
 - 1. CONTRACTOR shall submit to OWNER prior to beginning television inspection a schedule for sequence of sewer utilities designated to be televised.
- B. Television Inspection Logs:
 - 1. Inspection reports shall be prepared by CONTRACTOR to go along with the video inspection and will clearly show the location in relation to the downstream utility structure of each point of significance observed during inspection.
 - 2. Points of significance will include wyes, roots, connections, broken or collapsed utilities, scale, corrosion, and any other unusual conditions or discernible features. Each will be recorded in a written report and an electronic copy of such report will be supplied to OWNER in accordance with the most current NASSCO Pipeline Assessment Certification Program (PACP) standards.
 - 3. The importance of accurate distance measurements is emphasized to enable location of the defects for rehabilitation work.
- C. Video Inspection Recordings:
 - 1. Purpose of video inspection recordings shall be to supply a visual and audio record of problem areas that may be replayed by ENGINEER/OWNER. Video recording shall be submitted in electronic format.
 - 2. Upon completion of the work, CONTRACTOR shall deliver a complete electronic copy of a written condition report and the video inspection recording to ENGINEER/OWNER in accordance with Section 01 3300, Submittal Procedures.

1.05 Job Conditions

A. Sewer Cleaning:

1. Prior to CCTV work, sewer utilities shall be cleaned so any cracks or other defects can be observed during the CCTV inspection work. The designated utilities shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment as specified in Section 33 0130.53, Cleaning of Sewer Utilities.

B. Sewer Flow Control:

1. When depth of flow at the upstream of the utility section being worked is above the maximum allowable for television inspection, flow shall be reduced to the level shown below by operation of pump stations, plugging or blocking of the flow, or by pumping and bypassing of the flow as specified in Section 01 5000, Temporary Facilities and Controls, and/or Section 33 130.81, Sewer Utility Flow Control.
2. Depth of flow shall not exceed that shown below for the respective utilities sizes as measured when performing television inspection.
 - a. Maximum Depth of Flow:

(1)	6" - 10"	20% of diameter
(2)	12" - 24"	25% of diameter
(3)	≥ 27"	30% of diameter
 - b. When the depth of flow in the utility is above the maximum allowable, or inspection of the complete periphery of the utility is necessary to effectively conduct the television inspection operations, one or more of the following methods of flow control shall be used. Where high flows are encountered after the utility has been cleaned, priority consideration shall be given to scheduling the CCTV inspection work for the late-night hours between 11:00 p.m. and 6:00 a.m.

C. Flood Prevention:

1. When flow in a sewer line is plugged, blocked, bypassed, or in any other way restricted, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

D. Working Hours:

1. CONTRACTOR must complete all work such that no homeowner is without sewer service, unless otherwise directed by OWNER. Local noise ordinances or agencies having control over roadway closures may control starting or stopping operations. Prior to starting operations, CONTRACTOR shall advise OWNER of the restrictions imposed by the local agencies.
2. CONTRACTOR may be required to work days, nights or weekends to achieve the lowest depth flows in the utility and not conflict with public events.
- 3.

No work will be allowed on weekends or holidays except at the discretion of OWNER.

1.06 Accessibility

- A. Due to site constraints in specific areas of the sewer system, it is highly recommended that prospective bidders review the project site locations for accessibility. Entry onto private property without permission is not authorized. Where permission is denied, it shall be CONTRACTOR's burden to develop an alternative approach to inspecting the utility.

1.07 Quality Assurance

- A. Experienced and pre-qualified personnel utilizing equipment and materials meeting the requirements of these specifications shall perform the Work specified herein.
 - 1. Prequalification shall require that the contracting company to perform the specified television inspection by a certified NASSCO trained operator having a minimum of three (3) years experience in the performance of the type of work specified and shall have specifically performed at least 100,000 feet of cleaning and television inspection within the past three years.
 - 2. A company with less than three (3) years experience may pre-qualify if they can demonstrate to the satisfaction of ENGINEER that they have the capabilities and overall experience, equipment and expertise to satisfactorily complete the project in accordance with these specifications.
- B. The CCTV software, database, and inspection reports shall be NASSCO certified (current version).

Part 2 Products

2.01 Television Camera and Equipment

- A. Television camera used for the inspection shall be one specifically designed and constructed for such inspection:
 - 1. Camera shall be "Pan and Tilt", color. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the utility.
 - 2. Camera shall be operative in 100% humidity conditions.
 - 3. Camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of ENGINEER; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.
- B. Manual winches, power winches, television cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
 - 1. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to ensure good communications between members of the crew.

- C. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to ENGINEER.

Part 3 Execution

3.01 General

- A. CONTRACTOR shall locate all structures and note sewer diameter and direction of flow. Notify ENGINEER of detrimental access, structure, and/or sewer conditions which may adversely affect the progress of the Work. The inspection shall be done one manhole section at a time and the flow in the section being inspected shall be suitably controlled as specified herein. Closed-circuit television (CCTV) inspection shall be used to assess:
 - 1. Condition of existing utility.
 - 2. Root intrusion problems, if any.
 - 3. Internal defects that should be corrected and applicable repair or rehabilitation methods.
 - 4. Infiltration sources.
- B. CONTRACTOR shall coordinate on a daily basis and make provisions to ensure ENGINEER's representative is present whenever CCTV inspection work is being performed.
 - 1. While it is understood that ENGINEER's representative(s) may not always be present, CONTRACTOR understands that ENGINEER's representative(s) may be present at various points during the work to assess that quality requirements are carried on throughout the work.
- C. Inspections shall be performed while the line segments are in service without the need for plugging or flow diversion unless previously approved by ENGINEER. If necessary, CONTRACTOR shall schedule the work to be performed late at night between the hours of 11:00 PM and 6:00 AM. Late night CCTV inspection work shall not begin until CONTRACTOR has received approval from OWNER for a nighttime traffic control plan submitted by CONTRACTOR.

3.02 Maintenance of Traffic

- A. CONTRACTOR shall be responsible for maintaining traffic at all times and for notifying the proper authorities regarding the closing of roads. CONTRACTOR will be responsible for obtaining all permits required for maintenance of traffic.
- B. CONTRACTOR shall not begin work until standard barricades and warning signs are in an acceptable position and the markers and signs conform to the Michigan *Manual of Uniform Traffic Control Devices for Streets and Highways*, and all applicable state and local requirements. CONTRACTOR assumes all responsibilities and liabilities regarding strict adherence to applicable sections for the maintenance of traffic and public safety as set forth in the Michigan *Manual of Uniform Traffic Control Devices for Streets and Highways*, and other applicable regulations. Traffic control devices must be in place prior to starting work.

- C. CONTRACTOR shall maintain traffic at all times during all phases of this project in a manner causing the least amount of inconvenience to abutting property owners.
- D. Temporary driveways, temporary roadways, or run around as may be necessary to provide vehicular access to and from the abutting properties shall be constructed, maintained, and subsequently removed by CONTRACTOR as directed by OWNER and/or ENGINEER.
- E. The portion of the pavement not affected by the work shall be kept clear of all material and equipment. If at any time traffic has to be blocked (emergencies only), CONTRACTOR shall notify the nearest fire, police departments and service departments.
- F. Cost of maintenance of traffic shall be incidental to the Work and not measured for payment unless otherwise indicated.

3.03 Existing Utilities

- A. CONTRACTOR must take the necessary precautions for the protection of any utility encountered on the project or the restoration of any utility damaged during the work.
- B. If an excavation is required, CONTRACTOR shall notify, at least 48 hours before breaking ground, all public or private service corporations having wire, poles, pipes, conduit, manholes, or other structures that may be affected by this operation, including all structures which are affected and not shown on these plans. Owners of underground utilities, which are members of the state's one call service, can be notified by calling. Non-member underground utility owners must be called directly.
- C. Maintenance, repair, and replacement of existing utilities shall be in accordance with the rules and regulations of the various utility companies having jurisdiction.
- D. Existing storm sewers, drains, surface drainpipes and other property, removed or damaged during construction shall be repaired and reconnected by CONTRACTOR as directed by OWNER at no additional cost to OWNER.

3.04 Television Inspection and Computerized Equipment

- A. CONTRACTOR shall use a color pan and tilt camera or a side wall scanning (panoramic) camera specifically designed and constructed for sewer utility inspection. Each utility to be televised shall be suitably isolated to control flow during the inspection. CONTRACTOR shall provide a recording of the televised inspection, locating each connection entering the utility.
- B. Lighting for the pan and tilt camera or side wall scanning camera shall provide a clear picture of the entire periphery of the existing utility.
- C. The pan and tilt camera shall pause, pan, and visually inspect all connections, pipe ends, and maintenance or structural defects. If utilizing a camera with side wall scanning capabilities, pausing and panning of each lateral is not necessary during the inspection if the image clearly depicts the inside of the lateral for post processing. If a blockage cannot be removed and hampers the televising in one direction, then CONTRACTOR shall attempt to complete the section by televising from the other direction to complete the section, this reversal should immediately follow the initial direction. CONTRACTOR must immediately report the obstruction to OWNER.

- D. Side wall scanning inspection systems are imaging cameras that are capable of a continuous 360-degree image capture of the utility being inspected. These systems may have one or multiple cameras to capture the complete interior view of the utility.
- E. Once CONTRACTOR has completed the inspections, the captured images can be linked with a companion software package that allows for identifying and coding defects and features in the utility.
- F. If the image quality is not adequate for post-inspection coding, CONTRACTOR shall be required to repeat the survey at CONTRACTOR's expense.
- G. CONTRACTOR shall perform all CCTV inspections in accordance with NASSCO's Pipeline Assessment Certification Program (PACP). CCTV inspections will be delivered entirely in electronic format.
 - 1. Entire survey shall be recorded in an approved electronic format submitted with electronic links between the data and the video.
 - 2. Television inspection reports shall be within ± 2 feet of the measured linear footage between structures along the existing centerline of the utility from the start of the utility to the end of the utility.
 - 3. OWNER and PACP-required header information must be fully and accurately entered on all CCTV reports.
 - 4. Work not following these specifications may be rejected for payment and CONTRACTOR may be required to re-do the work.
- H. CONTRACTOR shall provide a PACP-certified operator onsite during the entirety of inspection activities.
 - 1. If video is to be coded separately from the actual recording, both the onsite operator and the individual performing the PACP coding shall be PACP certified.
 - 2. CONTRACTOR shall provide proof of certification prior to commencement of work, prior to a change in personnel involved in data collection, and as requested by OWNER.
- I. CCTV Reports, logs, electronic reports, and worksheets must include the following information and conform to the applicable guidelines:
 - 1. CCTV Reports, NASSCO PACP Certified Database, and electronic worksheets must accompany all inspection work.
 - 2. OWNER and NASSCO PACP required header information must be fully and accurately entered on all CCTV reports.

3.05 Unacceptable Conditions

- A. Camera lens shall be kept clean and clear and any fogging due to oil, grease, or other material or debris. Material that obscures the lens shall be cleaned off before proceeding with the recording operation. If debris or other obstructions cause reduced visibility, or if the image is obscured, CONTRACTOR shall make reasonable attempts to clear the lens of the camera before continuing inspection.
- B.

Camera lens shall remain above the visible water level and may submerge only while passing through clearly identifiable line sags. If at any time the flow exceeds 25 percent of the diameter of the utility, the inspection must be stopped until the flow subsides or, if necessary, CONTRACTOR shall reschedule the inspection, possibly for a late night inspection.

- C. Other unacceptable conditions that shall serve as a cause for rejection of submitted videos include, but are not necessarily limited to:
 - 1. Loss of vertical hold which impacts the ability to read and interpret the video.
 - 2. Incorrect manhole identifications if it is not clear which line has been televised.
 - 3. Inaccurate footage readings. The footage measurements shall form the basis for possible subsequent repair or rehabilitation work.
- D. Inaccuracy in the continuous footage measurement to a defect or any identifiable feature which leaves doubt as to the accuracy of the location of a specific defect or the total length of the utility segment shall render the video of the segment as unacceptable.
- E. Other unidentifiable defect such as equipment interference or malfunction, blurred or obscured images from an unknown source that detracts from the ability to read the video with reliable accuracy.

3.06 Property Damage

- A. CONTRACTOR shall immediately investigate any and all reports of flow backing up into fixtures served by the utility section that is being cleaned or televised.
- B. CONTRACTOR will be required to notify OWNER immediately if he causes any damage to private or public property caused by activities related to this Contract. CONTRACTOR shall make repairs and/or clean the property immediately in a timeframe that is acceptable to OWNER.

3.07 Cleanup

- A. CONTRACTOR shall keep the work area in an uncluttered condition by the frequent removal of debris. CONTRACTOR shall remove all debris and unused material and leave the area in a condition similar to the condition of the area before any work was performed.

End of Section

Section 33 0130.53

Cleaning of Sewer Utilities

Part 1 General

1.01 Scope of Work

- A. CONTRACTOR shall provide materials, labor, equipment, and services necessary for sewer line cleaning, manhole cleaning, and internal obstruction removal.
 - 1. Cleaning shall remove sediment, rocks, debris, roots, grease accumulations and obstructions from length of sewer and manholes to be lined, as well as hydraulic root cutting and/or grinding/cutting protruding break-in service connections
 - 2. Cleaning of sewer and manhole walls in vicinity of lining shall remove grease, scale, encrustation and loose mortar so that no foreign intrusion shall cause imperfections in lining (e.g. bumps, folds, dimples).
 - 3. Sewer cleaning methods shall be washing with high pressure water or other as approved by ENGINEER.

1.02 Related Work Specified Elsewhere

- A. Section 33 0130.16: Television Inspection of Sewer Utilities

1.03 Submittals

- A. Methods:
 - 1. CONTRACTOR shall submit a letter that identifies methods that will be used to remove sediment, debris, grease, scale, encrustations, loose concrete, roots and break-in connections throughout section of sewer to be cleaned. Include the following:
 - a. Detailed explanation of cleaning process.
 - b. Schedule of activities.
 - c. References where identified cleaning method(s) has been used successfully in the past by CONTRACTOR.
 - d. List of the actions to mitigate impact to OWNER during cleaning operation.
- B. Schedule:
 - 1. CONTRACTOR shall submit a schedule that outlines the sequence in which CONTRACTOR proposes to conduct his operations and shall be approved by OWNER before work is started. Original and updated schedules must be provided to OWNER electronically. The schedule shall:
 - a. use a time-scaled logic diagram format;
 - b. provide a level of detail of activities that are clear and concisely communicate of the plan of work; and
 - c. at a minimum show initial mobilization, start-up, cleaning and televising, and any resultant point repairs shall be included.

2. Software used for producing the schedules must have the capability to tailor the form and format of schedules, and accompanying reports, to OWNER's requirements.
3. OWNER may require additional updates to the schedule as changes occur. These additional updates will be submitted to ENGINEER within 24 hours of the request.
4. Changes to the schedule are subject to approval of OWNER.

Part 2 Products

2.01 Materials

- A. Do not use chemicals without written approval of ENGINEER. Do not use chemical which may be considered hazardous or detrimental to organisms or equipment of wastewater treatment plant.

2.02 Equipment

- A. High-Velocity Hydraulic (Hydro-Cleaning) Equipment: Equipment shall be capable of removing dirt, grease rocks, sand, roots, and other materials and obstructions from sewer lines and manholes.
 1. Equipment shall have selection of two or more high-velocity nozzles. Nozzles shall be capable of producing scouring action from 15 to 45 degrees in all size lines designated to be cleaned, with nozzle capable of producing flows from fine spray to solid stream.
 2. Equipment shall carry its own water tank, auxiliary engines, and high-pressure water pump.
 3. Combination Unit Pump: Capable of pumping at least 80 gallons per minute (300 liters per minute) at 2,000 psi (13.8 MPa), measured at beginning of hose reel.
 4. Water Pump: Able to run at 2,000 psi (13.8 MPa) while pulling full vacuum, completely independent from vacuum system, with ability to vary vacuum without affecting water pressure.

2.03 Water

- A. When water from fire hydrants is necessary, apply to OWNER for permission to use potable water source. When CONTRACTOR has been authorized to take water from fire hydrants:
 1. Water shall be conserved and not used unnecessarily.
 2. Only approved fire hydrant wrenches and shut off valves shall be used.
 3. A visible air gap shall be maintained between the discharge of the fire hose and CONTRACTOR's water storage tank. The air gap shall be visible from the ground surface.
 4. No fire hydrant shall be obstructed except to refill empty water tanks.
- B. CONTRACTOR shall provide temporary piping, valves, certified reduced pressure backflow preventors, equipment, and other items for handling potable water and wastewater.

- C. Do not utilize water source until it has been approved for use by OWNER.

Part 3 Execution

3.01 General

- A. CONTRACTOR shall clean the sewer and associated manholes, including drop connections and benches, to remove all Deposits Settled (DS), so that the sewer is ready for televising. This will require an unlimited number of passes of a hydraulic flusher to remove all loose debris and collect it for removal in the downstream manhole. All debris must be removed from the sewer, including any debris that may have been washed up into any service connections (does not include known pre-existing conditions in service connections), drop connections or the bench wall of the manholes. This item does not include any root cutting, deposit removal, or grinding of protruding service connections.
- B. Cleaning shall be performed while the line segments are in service without the need for plugging or flow diversion unless previously approved by ENGINEER. If necessary, CONTRACTOR shall schedule the work to be performed late at night between the hours of 11:00 PM and 6:00 AM.

3.02 Existing Utilities

- A. CONTRACTOR must take the necessary precautions for the protection of any utility encountered on the project or the restoration of any utility damaged during the work.
- B. If an excavation is required, CONTRACTOR shall notify, at least 48 hours before breaking ground, all public or private service corporations having wire, poles, pipes, conduit, manholes, or other structures that may be affected by this operation, including all structures which are affected and not shown on these plans.
- C. Maintenance, repair, and replacement of existing utilities shall be in accordance with the rules and regulations of the various utility companies having jurisdiction.
- D. Existing storm sewers, driveway drains, surface drain pipes and other property, removed or damaged during construction shall be repaired and reconnected by CONTRACTOR as directed by OWNER at no additional cost to OWNER.

3.03 Maintaining Flow

- A. It will be the responsibility of CONTRACTOR, throughout the tenure of this Contract, to provide and maintain sufficient flow at all times to pass any flash of flow and prevent any backwater flooding due to obstruction caused by cleaning equipment.
- B. CONTRACTOR shall be aware of flow conditions and be able to identify potential access problems to sewer access points.

3.04 Sewer Cleaning

- A. CONTRACTOR shall provide equipment that is specifically designed and constructed for sewer cleaning. Solids and debris resulting from the cleaning operation shall be collected and removed from the downstream manhole and disposed of at a site selected by OWNER and approved by appropriate jurisdictional personnel. Under no circumstances shall sewage solids be dumped onto the surface, street, or into ditches, inlets, or storm drains.
- B. CONTRACTOR shall use the manufacturer's recommended size tools for the various size pipes. Equipment recommended by the manufacturer to protect the manhole and pipe, such as pull-in slant jack rollers and roller and yoke assembly, roller manhole jacks, etc. shall be utilized.

- C. CONTRACTOR shall clean designated sewer lines using approved methods and equipment.
1. CONTRACTOR shall have a CCTV camera in the sewer during all cleaning operations to verify that the cleaning equipment is not damaging the public sewer. The use of CCTV equipment shall be in accordance with Section 33 0130.16, Television Inspection of Sewer Utilities.
 2. Remove internal obstructions such as roots or gaskets by trenchless techniques when obstruction encountered prevents further pipe cleaning.
 - a. Provide special attention during cleaning operation to assure almost complete removal of roots from joints.
 - b. Procedures to remove internal obstructions may include use of equipment such as rodding machines, root saws, bucket machines and winches using root cutters, porcupines, and jet machines equipped with hydraulically driven cutters.
 3. If cleaning of entire section cannot be successfully performed from one manhole, set up equipment at other manhole and attempt cleaning again.
 - a. If successful cleaning cannot be performed or equipment fails to traverse entire sewer line section, it will be assumed that major blockage exists.
 - b. Temporarily suspend cleaning effort and immediately notify OWNER and ENGINEER.
 - c. Upon removal of obstruction, complete cleaning operation.
 4. Employ satisfactory precautions to protect sewer line from damage that might be inflicted by improper use of cleaning equipment.
 - a. Immediately notify OWNER and ENGINEER if fresh soil, pieces of pipe, or other visible signs of potential problems occur during cleaning operation.
 - b. Ensure that water pressure created does not cause damage due to flooding of property being served by sewer section(s) involved.
- D. CONTRACTOR is required to submit documentation of the work that is performed and the type of debris removed, as well as landfill permits and disposal documentation.

3.05 Manhole Cleaning

- A. Include entire manhole interior, including manhole benches and walls. Incorporate into line cleaning operation by scouring walls with high velocity nozzle after pipe segment cleaning operation is complete.

3.06 Removal of Debris

- A. Sludge, dirt, rocks, sand, grease and other solids or semisolid materials resulting from cleaning operations shall be trapped and removed at the downstream manhole of the section being cleaned.
- B. Passing materials from manhole section to manhole section, which could cause line stoppage, accumulations of sand in wet wells or damage to pumping equipment, shall not be permitted.

- C. Solids or semi-solid material removed from the wastewater collection system during the cleaning operation shall be removed from the site and disposed of in a lawful manner. Do not discharge sewage or solids removed from downstream manholes, onto streets, or into ditches, catch basins or storm drains.

3.07 Property Damage

- A. CONTRACTOR shall immediately investigate any and all reports of sewage backing up into fixtures served by the sewer section that is being cleaned or televised.
- B. CONTRACTOR will be required to notify OWNER immediately if he causes any damage to private or public property caused by activities related to this contract. CONTRACTOR shall make repairs and/or clean the property immediately in a timeframe that is acceptable to OWNER.

3.08 Cleanup

- A. CONTRACTOR shall keep the work area in an uncluttered condition by the frequent removal of debris. CONTRACTOR shall remove all debris and unused material and leave the area in a condition similar to the condition of the area before any work was performed.

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 31 2319: Dewatering
- B. 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 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 $\pm 1/16$ 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.

2.03 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.

2.04 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.

2.05 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.

2.06 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.

2.07 Steel Pipe

- A. Pipe shall conform to ASTM A53, black and hot-dipped galvanized welded and seamless pipe of standard weight.

2.08 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.

2.09 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/m³); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's approval.

2.10 Concrete Reinforcement

- A. In accordance with MDOT Section 905, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

2.11 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/m³) (minimum)
 - b. Cement: 100 lbs/cyd (60 kg/m³) (minimum)
 - c. Water: Sufficient water to produce the desired flowability (approximately 700 lbs/cyd) (415 kg/m³)
- 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 be 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 0500

General Equipment Requirements

Part 1 General

1.01 Description

- A. This Section includes general provisions and requirements for all equipment to be furnished and installed as indicated on the drawings complete with safety guards, anchor bolts and lubrication. This Section also includes component name plates, structural process modification requirements and maintenance prior to final acceptance.

1.02 Related Work Specified Elsewhere

- A. Section 04 0513: Mortar and Masonry Grout
- B. Section 26 0500: Electrical General Requirements

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. AFBMA - Antifriction Bearing Manufacturing Association
 - 2. ANSI - American Standards Association
 - 3. AMCA - Air Moving and Conditioning Association
 - 4. ASA - American Standards Association
 - 5. ASTM - American Society for Testing Materials
 - 6. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
 - 7. ASME - American Society of Mechanical Engineers
 - 8. AWWA - American Water Work Association
 - 9. FM - Factory Mutual
 - 10. NEMA - National Electrical Manufacturers' Association
 - 11. NFPA - National Fire Protection Association
 - 12. UL - Underwriters Laboratories, Inc.

1.04 Deviations and Modifications

- A. Motor Size:
 - 1. Deviation from motor sizes specified or indicated on the Plans recommended to accommodate any particular piece of equipment specified in various Sections of this Division shall strictly comply with these Specifications. The CONTRACTOR shall include with his bid any additional engineering and construction costs necessary to redesign the mechanical and/or electrical services recommended

through CONTRACTOR by equipment manufacturer or supplier. No deviations will be permitted without written approval by the OWNER.

B. Structure/Process Modification:

1. Modifications to the structure or process configuration for ease of installation, operation or maintenance for a particular piece of equipment shall be accomplished by CONTRACTOR. CONTRACTOR shall include with his bid any additional engineering and construction costs necessary to perform modifications recommended by or through the CONTRACTOR by equipment manufacturer or supplier. No modifications will be permitted without written approval by the OWNER.

C. Codes, Ordinances, Permits, and Inspections:

1. Materials and equipment required for the Work and their installation shall conform to the laws of the State and to all the codes, rules, regulations, and ordinances of the locality where the Work is to be performed. CONTRACTOR shall secure all permits, licenses, inspections and tests required in connection with his Work, however, OWNER shall or has paid for these permits as described in Section 01 1100 Summary of Work. Upon completion of the Work, CONTRACTOR shall secure and present to OWNER a certificate of inspection and approval from the department having jurisdiction over his Work, if such be issued.
2. CONTRACTOR shall be required to conform to the above ordinances, laws, rules, and/or regulations without extra expense to OWNER, except in the instance of ordinances, laws, rules, and/or regulations which are revised or enacted subsequent to the time of signing the Contract.

D. Contractors' Interface:

1. CONTRACTOR shall be responsible to coordinate the furnishing and installation of all materials and labor required for a complete and operable facility.
2. CONTRACTOR shall be responsible to include adequate appurtenances to complete installation of equipment furnished by him including motor starters when furnished as an integral part of a packaged piece of equipment or integral mechanical equipment system.
3. CONTRACTOR shall be responsible for furnishing and installing the necessary piping to provide a complete and operable installation of all equipment and fixtures whether or not furnished by CONTRACTOR.

1.05 Submittals

A. Installation Inspection Report:

1. Submit inspection report performed on installed equipment made by the representative of manufacturer or supplier. Report shall certify that equipment has been properly installed, lubricated, ready for operation and results of test operation. See Article 3.03 of this Section.

B. Operation and Maintenance Data:

1. CONTRACTOR shall submit operating instructions, repair parts lists, equipment manuals, and automatic control diagrams. The submittals shall be as required in Section 01 3300, Submittal Procedures.

C. Record Drawings:

1. Submit record drawings as required in Section 01 7700, Closeout Procedures. Drawings shall be of the same digital format as the Plans obtained from ENGINEER and paid for by CONTRACTOR, clearly marked by CONTRACTOR with accurate field dimensions locating mechanical systems, equipment, piping, component parts, etc.

1.06 Product Delivery, Storage, and Handling

- A. Materials and equipment distributed, stored and placed upon or near the site of the work shall at all times be so disposed as not to interfere with work being prosecuted by other contractors in the employ of the OWNER, or with street drainage, fire hydrants or with access thereto, and not to hinder any more than may be necessary, the ordinary traffic of streets or OWNERS facility driveways.
- B. Materials may be stored on the site in locations designated by the OWNER. Equipment, machines, electrical or instrumentation components and other devices, which are not intended to be permanently installed outside, shall not be stored outside. These items shall be stored in climate controlled (heated) locations until permanently installed.
- C. Materials and equipment shall be handled in a manner to avoid damage or breakage and delay in the completion of the Work. The CONTRACTOR shall repair or replace, without cost to the OWNER and to the satisfaction of the OWNER, all items damaged or broken as a result of his operation.
- D. Machined surfaces of the equipment subject to corrosion shall be protected by coating with grease immediately after finishing.
- E. Flanges shall be protected prior to installation by means of wooden flanges bolted in place.
- F. Pump casings shall be thoroughly drained of all water.
- G. Parts of the equipment shall be carefully crated to facilitate shipping and handling. Cates shall be constructed to completely protect the equipment and shall be sufficiently strong to permit lifting and skidding without requiring additional bracing or reinforcement.
- H. Materials to be incorporated in the Work shall be properly arranged, covered and protected, in accordance with manufacturer's recommendations, and CONTRACTOR shall be solely responsible for the safety of the same. Material improperly stored shall not be included in estimates for partial payment, or if already included, shall be deducted from subsequent estimates.

1.07 Job conditions

- A. Protection and Maintenance:
 1. CONTRACTOR shall provide adequate protection of installed equipment and systems until final acceptance by OWNER. Maintenance of installed equipment shall be the responsibility of CONTRACTOR until final acceptance by OWNER.

1.08 Cutting and patching

- A. Minor cutting that may be necessary for the installation of the Work and any minor patching as a consequence thereof shall be done by the CONTRACTOR after review by the ENGINEER.

- B. Major cutting of the structure necessary for the installation of the mechanical Work and major repairs required as consequence thereof shall be done by CONTRACTOR, after review by ENGINEER.

Part 2 Products

2.01 Materials

- A. When specific manufacturers or trade names are mentioned in these Specifications, and/or on the drawings, they are used as the design criteria and to establish a minimum of quality standard.
- B. Any substitution made that may affect building size or process function shall be deemed to be made for the convenience of CONTRACTOR, and all shall be brought to the attention of ENGINEER at an early date for consideration. Any additional costs resulting therefrom shall be borne by CONTRACTOR.
- C. CONTRACTOR shall accept full responsibility that said substitution shall function as required by the process and shall not require additional building space or additional structural requirements. CONTRACTOR shall also be responsible for all redesign expenses incurred because of the substitution.
- D. Items required to complete the Work and not specifically mentioned herein, shall conform fully to the quality pattern established by these Specifications.
- E. Materials shall be new and be the standard products of the manufacturer. Seconds, rejects, or damaged materials will be rejected by CONTRACTOR. ENGINEER reserves the right to disapprove and reject any materials, proposed or installed which fail to meet these quality standards. CONTRACTOR shall, at his own expense, remove and replace with approved materials, any materials which do not comply with these standards.

2.02 Equipment

- A. General:
 - 1. All accessories or appurtenances to mechanical or process equipment, such as remote switches, push buttons, relays, overloads, pilot lights, motors, or other items, shall conform to and be installed as required by this or other specification sections.
 - 2. Equipment shall be completely coated for corrosion resistance. If finishes are not specified in Division 9, all equipment shall be provided with manufacturers standard primer and finish coats for the life of the equipment. Touchup finish paint shall be provided and delivered with the equipment. If finish coatings are specified in Division 9, then equipment shall be delivered with all ferrous surfaces primed and ready for finish coating. CONTRACTOR shall coordinate compatibility of factory priming systems and finish coatings.
 - 3. Provide any and all special tools needed for assembly, disassembly or maintenance of the equipment. Deliver in a toolbox labeled for the equipment in question.
 - 4. Provide nameplates on each component of equipment, unless otherwise specified.
 - a. Plates shall clearly identify manufacturer catalog or model number, serial number and other data pertinent to operation.

- b. Securely attach plates to components or have data stamped or cast into the body.
- c. Plates or stampings shall be located in a position to be easily and fully visible after components are installed without removing any parts from the component.
- d. Only rigid metal plates riveted or screwed to components will be acceptable.

B. Low Voltage Motors (600 Volts and Below):

- 1. Motors shall meet the requirements of Section 26 2000 Low Voltage Motors.
- 2. Close coupled motors are generally not allowed. Fractional horsepower motors may be coupled to driven equipment if specifically called for in other specifications. All other motor to driven equipment shall be provided with a flexible coupling between motor and equipment.

C. Guards:

- 1. Provide and install safety guards for all belts, gears, shafts or other reciprocating, rotating or moving parts of equipment whether shown on the Plans or required by ANSI B15.1, Safety Standard for Mechanical Power-Transmission Apparatus. Paint guards safety yellow unless otherwise directed by ENGINEER or specified elsewhere.
- 2. Guards shall be fabricated from galvanized or aluminum-clad sheet steel no thinner than 16 gage or galvanized 1/2-inch mesh expanded metal. Each guard shall allow for easy installation and removal. Supports and accessories shall be included with guards. Supports and accessories, including bolts, shall be hot dip galvanized.
- 3. Safety guards in outdoor locations shall prevent the entrance of rain and dripping water.

D. Bearings:

- 1. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L 10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.
- 2. Equipment shall be provided with sufficient lubrication, installed or in separate containers, for 12 months of continuous operation.
- 3. Equipment shall not require lubrication more frequently than bi-weekly, unless automatic oilers or greasers are provided.
- 4. Lubrication fittings, such as grease or oil fill fittings, shall be accessible without any equipment disassembly. Extensions shall be provided where necessary. Grease purge tubing and oil drain piping shall similarly be treated. Oil drains shall be provided with valved drains to a point where containers can be placed.

Part 3 Execution

3.01 Installation

A. Equipment:

1. Supports and Anchors:

- a. Provide bases, pads, platforms, hangers, clamps, or embedded inserts necessary for proper support and/or anchoring of mechanical and process Work. The CONTRACTOR shall be responsible for the proper sizes, locations, and quantities of these bases and pads where same are to be on concrete floor slabs, and shall provide all anchor bolts, sleeves, and setting templates for the mechanical equipment and machinery.
- b. A 4-inch-high concrete housekeeping pad shall be provided for each piece of mechanical equipment and machinery whether shown or not shown on the drawings.
- c. Anchor bolts, nuts, washers, and sleeves shall be furnished as per the manufacturer's recommendations and shall be made of ample size and strength for the purpose intended. All anchor bolts, bolt sleeves, washers and nuts supplied shall be stainless steel unless otherwise specified. Setting templates and working drawings for installation shall be furnished.
- d. Unless otherwise indicated on the Plans or specified elsewhere, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and housekeeping pad, and to provide adequate anchorage into structural concrete. Unless otherwise noted, all equipment baseplates shall be furnished complete with openings for grout.
- e. Mechanical equipment resting on concrete foundations, bases or pads shall rest on a level and uniform bearing surface with grout when vibration isolation is not required or specified. Grout shall be nonshrink, nonstaining Type V as specified in Section 04 0511, Mortaring and Grouting.

B. Identification:

1. Mechanical equipment including pumps, air handling units and each and every valve and regulator shall be identified in accordance with other Sections of these Specifications.

3.02 Field Quality Control

A. Testing:

1. During and after installation, those tests required by the local, county and state inspection bureaus, OWNER or ENGINEER, shall be performed in strict accordance with the department concerned and at the full expense of CONTRACTOR.
2. CONTRACTOR shall furnish all equipment, lubrication, water, compressed air, apparatus, and labor necessary for the test. Defects disclosed by the tests shall be rectified by CONTRACTOR without cost to OWNER. Tests required by OWNER after installation are outlined in paragraph 3.03 of this Section.

3. Equipment shall be tested as in normal operating service unless specific rating tests are required as results of questionable performance.
 4. Gages and equipment, etc., which may be damaged by the tests shall be valved off or removed before testing.
 5. Special tests required for certain apparatus are specified under the specific headings for that apparatus.
 6. In general, visible or audible leaks shall be fixed regardless of previous testing results.
- B. Final Inspection:
1. Upon completion of the Work, CONTRACTOR shall conduct a complete inspection of all items of Work instituted by the Contract obligations; and make whatever corrections and adjustments deemed necessary to a well-functioning system, same to meet the satisfaction of ENGINEER and OWNER.
 2. CONTRACTOR shall signify his readiness for final inspection in writing to ENGINEER. The time of inspection may occur at the time of "Operating and Instructions." Inspection shall be made in the presence of OWNER and ENGINEER.

3.03 Equipment Startup

- A. Installation Inspection and Testing
1. After completion of the installation, all systems and equipment shall be tested by CONTRACTOR in the presence of ENGINEER under actual operating conditions. Tests shall be performed according to manufacturer's recommendations, and documented with an Installation Inspection Report, as included at the end of this Section.
 2. Installed equipment shall be operated under full working load conditions before being accepted by ENGINEER as ready for satisfactory operation. Each piece of equipment shall be certified by the representative that installation is correct and ready for satisfactory operation. Such test operation shall last 4 hours, or until it is demonstrated to OWNER and ENGINEER that the equipment is ready for acceptance or trial operation.
 3. Manufacturer or supplier of each piece of equipment shall provide the services of a representative to field review installation procedures with CONTRACTOR, inspect installed equipment and adjust for satisfactory operation. CONTRACTOR shall include with his bid the services of all required equipment manufacturer's field service technician for a period necessary to complete the work to the satisfaction of ENGINEER and OWNER. The representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment. A written Installation Inspection Report covering the representative's findings and installation approval shall be submitted to ENGINEER covering all inspections and outlining in detail any deficiencies noted.
 4. Specific requirements, if any, such as trial operation, for a particular system or piece of equipment are contained in the particular specification sections.
 5. CONTRACTOR's responsibility relative to coordinating these services are contained in Section 01 7700, Closeout Procedures.

B. Trial Operation:

1. Certain specified equipment will be required to complete a trial operation period. During this period the equipment will be placed in normal operation and will run either manually or automatically as determined by OWNER to be in the best interest of the facility. During this period OWNER will provide the power, operating supervision, and normal operation maintenance activities, however, the equipment shall remain the property of CONTRACTOR, and shall not be accepted by OWNER until successful completion of the trial operation period.
2. CONTRACTOR and/or manufacturer may be present during the trial operation if desired. Unless otherwise required by the individual specification sections, the trial operation period shall be one (1) 8-hour day. Trial operation may not commence until permanent power, controls, alarms, connecting piping and appurtenances and any devices or systems required for full automatic operation are completed, tested and ready for final inspection.
3. If during the trial operation period the equipment fails, causes alarm conditions, becomes overloaded, over temperature or in any way fails to perform in accordance with the contract requirements, the equipment shall be repaired, replaced or corrected to a new and perfect condition, and the trial operation period begun anew.

3.04 Adjustment and Cleaning

- A. Before turning the project over to the OWNER, clean all fixtures, piping, covering, exposed metal surfaces and leave all in clean condition at the end of the Work and remove from the premises all refuse, dirt and rubbish which are a result of the mechanical Work or workmen. Also, remove from the premises all cartons, scrap, and major debris at least once a week during progress of the Work.
- B. Instruments used in the checking, adjusting, and balancing shall be accurately calibrated and maintained. Accuracy tests on instruments shall be performed in the presence of and whenever requested by OWNER or ENGINEER.
- C. Air and water balance and checking shall not begin until systems have been completed and are in full working order. CONTRACTOR shall put heating, ventilating, and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.

3.05 Operation and Maintenance Training

- A. Provide services of manufacturer's service representative to instruct owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.
- B. Manufacturer's representative shall provide 1 day, 8 hours, on-Site training, unless specified otherwise is individual specification sections.
- C. Review operating and maintenance data contained in the operating and maintenance manuals.
- D. Schedule training with OWNER, provide at least 15-day prior written notice to ENGINEER.

3.06 Equipment Acceptance

- A. Equipment, components and facilities shall be deemed accepted by the OWNER, and the warrantee start dates established, by the execution of a Certificate of Substantial Completion, Section 00 6516.
- B. Except, if required by the specifications or drawings, and/or if requested by the OWNER, individual equipment items, or systems, or components, may be accepted prior to Substantial Completion. Such partial acceptance shall be documented with a Partial Component Acceptance Form, appended to this Specification Section. Acceptance requirements, including but not limited to approved shop drawings, O&M manuals, Installation Inspection Report, testing and trial operation, shall apply.

End of Section

JOB NAME:_____

CONTACT-MANUFACTURER:_____TELEPHONE:_____

PERFORMED BY:_____ **DATE:**_____

EQUIPMENT _____

MOTOR/MFGR;_____

ELAPSED TIME METER READING (IF AVAILABLE) _____

EQUIPMENT HAS BEEN PROPERLY INSTALLED_____

ELECTRICAL EQUIPMENT (STARTER) HAS BEEN PROPERLY CHECKED AND OVERLOAD DEVICES ARE APPROPRIATE FOR MOTOR/EQUIPMENT_____

EQUIPMENT IS IN PROPER ALIGNMENT_____

OPERATOR/OWNER HAS RECEIVED INSTRUCTION, PARTS MANUALS & DRAWINGS:_____

FLOW RATE (IF APPLICABLE)_____

VOLTAGE:

AMPERAGE:

VIBRATION: **MOTOR INBOARD**_____

MOTOR OUTBOARD

EQUIPMENT INBOARD_____

EQUIPMENT OUTBOARD

NOISE:

[illegible]

SIGNATURE	REPRESENTING OWNER	DATE
SIGNATURE	REPRESENTING CONTRACTOR	DATE
SIGNATURE	REPRESENTING MANUFACTURER	DATE

PARTIAL COMPONENT ACCEPTANCE FORM

PROJECT NAME: _____

OWNER NAME: _____

ACCEPTANCE DATE: _____

DESCRIPTION OF COMPONENT TO BE ACCEPTED BY OWNER PRIOR TO CONTRACT SUBSTANTIAL COMPLETION DATE:

IT IS ACKNOWLEDGED THAT AFTER THE DATE OF THIS COMPONENT ACCEPTANCE FORM THE OWNER IS RESPONSIBLE FOR OPERATION, MAINTENANCE AND PROTECTION OF THE DESCRIBED EQUIPMENT. FURTHER, THE WARRANTY PERIOD BEGINS ON THE DATE OF THIS DOCUMENT.

SIGNATURE

REPRESENTING OWNER

DATE

SIGNATURE

REPRESENTING CONTRACTOR

DATE

SIGNATURE

REPRESENTING ENGINEER

DATE

Section 40 0505 Exposed Piping Installation – General

Part 1 General

1.01 Work Included

- A. This section of these specifications is intended to outline the basic construction methods and materials to be used for the installation of all piping and equipment systems, and such other work and materials that shall be used to meet the Contract requirements of the process and mechanical systems for the project to the best accepted level of practice, to meet the requirements of governing codes and as approved by OWNER.

1.02 Coordination

- A. Before proceeding with installation of piping, CONTRACTOR shall inspect the contract documents and determine that the location of the work does not interfere with other work. In case of interference, OWNER shall be notified in writing. OWNER will then determine the resolution of the conflict and his decision shall be binding.

1.03 Related work Specified Elsewhere

- A. Section 09 1000: Piping Identification
- B. Section 09 9000: Painting and Coatings

1.04 Submittals

- A. Shop drawings are required for each item in this section of the specifications, including, but not limited to bolts, studs and nuts; anchors; inserts and anchor bolts, pressure gauges; pipe guides; insulation; fasteners; brackets; hangers; supports; etc., in accordance with Section 01 3300, Submittal Procedures.

Part 2 Products

2.01 Piping

- A. In the description of piping materials, the following abbreviations are used:

1.	T & C	Thread & Couple
2.	Blk	Black
3.	stl	Steel
4.	M.I.	Malleable Iron
5.	F.S.	Forged Steel
6.	C.S.	cast steel
7.	C.I.	cast iron
8.	D.I.	ductile iron
9.	Scrd	Screwed
10.	Thk	Thick
11.	Galv	Galvanized
12.	Flgd	Flanged
13.	Sched.	Schedule

- B. "Ratings" in this description of piping materials shall be taken to mean American National Standard Institute ratings.

2.02 Bolts, Studs and Nuts

- A. Steel bolts, studs and nuts shall be in conformity with the current Tentative Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, ASTM Designation: A-307, Grade B.
- B. Carbon steel bolts and nuts used for joining flanged pipe shall be galvanized or cadmium plated unless otherwise called for. All bolts shall be coated with anti-seize compound prior to assembly.
- C. Sleeves for anchor bolts shall be made of Schedule 40 steel pipe and shall be at least 1/2 inch larger in inside diameter than the anchor bolt.

2.03 Anchors

- A. Anchors shall be provided to rigidly and securely fasten piping to building construction where shown or as required.
- B. Anchors shall be selected and located in such a manner that they will not distort any part of the building as the result of expansion and contraction of piping.
- C. Anchors may be angle iron, inserts, U-bolts and anchor chairs, or a combination of the above. Anchors may also be the screwed coupling type.

2.04 Inserts and Anchor Bolts

- A. Piping which must be supported from concrete walls, ceiling slabs, columns and other building masonry (except floors) shall be attached by means of approved inserts embedded in concrete or masonry, unless otherwise noted.
- B. Inserts shall be continuous slotted inserts approximately 1-5/8" wide, 1-3/8" deep by length as required, roll formed not less than 12 gage steel into slotted "U" conformation for 5/8 in. bolt size unless otherwise indicated, with anchors spaced on not more than 6 in. centers, plates and bolts and nuts as required by conditions, shall be provided. Slotted inserts shall be Gateway Erectors, Inc., Type "G", Hohman and Barnard Type CH05, or ENGINEER-approved equal.
- C. Piping to be secured to floor slabs or concrete bases shall be supported with approved prefabricated supports anchored to the floor or cast in place concrete supports.
- D. Drilled expansive anchor bolts are permissible provided that electric hammers are used, and that the specific hammers have been approved for the purpose by the OWNER. Anchor bolts shall be Wejit, Parabolts, Kwikbolt, or equal. All bolts shall be stainless steel coated with anti-seize compound prior to assembly.

2.05 Pressure Gauges

- A. Pressure gauges shall be provided and installed on the suction and discharge lines of each pump. Range for the gauges shall be 0-50 psi on the discharge and 15-0-15 psi on the suction. Gauges shall be a minimum of 4 inches in diameter and shall be glycerin filled. Rated accuracy shall be one (1%) percent of full-scale reading. Gauges shall be Ashcroft or equal.
- B. Gauges shall be mounted firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings and shall include a shutoff valve and sludge/solids isolater installed in each gauge line at the point of connection to suction and discharge pipes. Isolater shall be Red Valve Series 742 or equal.

2.06 Pipe Guides and Spacing

- A. Approved pipe alignment guides shall be provided in the piping adjacent to and on each side of all pipe expansion joints and loops, in order to control the pipe movement in true perpendicular alignment to the expansion joints and loops.
- B. First guides at 4 pipe diameters on each side of device.
- C. Second guides at 14 pipe diameters beyond first guide.
- D. Intermediate guides per standard of Expansion Joint Manufacturers Association (EJMA).

2.07 Pipe Insulation

- A. Potable water, service water, and dewatered cake pipes shall be insulated.
- B. Insulation shall be manufactured by Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com or ENGINEER-approved equal.
- C. Insulation shall meet the minimum thickness requirements of ANSI/SSHRAE/IES Standard 90.1-2019 "Energy Standard for Buildings Except Low-Rise Residential Buildings".
- D. Insulation shall have PVC vapor barrier (jacket) ASTM D1784, Class 16354-C; 0.020 in thick PVC jacketing and fitting covers manufactured by Proto Corp., Clearwater, FL 33762; www.protocorporation.com or ENGINEER-approved equal.

2.08 Hangers and Supports

- A. Hangers and supports shall be manufactured by Grinnell, Elcen, or B-Line by Eaton; or ENGINEER-approved equal.
- B. Hangers and supports for insulated piping shall include insulation protective shields.

Part 3 Execution

3.01 Excavation and Backfilling - Underground Piping

- A. CONTRACTOR shall perform all necessary excavating, trenching, backfilling, shoring and restoring, in connection with his work as specified herein. Excavations shall conform to the invert dimensions designated on the drawings or as required by field conditions and/or directed by OWNER.
- B. On excavations which occur near and below any foundation footings, the backfilling materials shall consist of concrete poured up to the level of the bottom of footing of the same strength as the concrete in the footings.
- C. Crossing Protection: Adequate temporary crossovers for pedestrian and vehicular traffic shall be provided including guard rails, lamps and flags, as required by agencies having jurisdiction and as directed by OWNER. Items shall be removed when necessity for such protection ceases.

3.02 Underground Piping Installation

- A. No piping shall be installed in filled or disturbed earth until the earth has been compacted to properly support general construction, as specified in the backfill requirements.

- B. Trenches shall be dry and clean when pipe is being laid.
- C. Pipe and fittings shall be inspected for defects prior to being lowered into the trench and shall be cleaned both inside of the bell and outside of the spigot.
- D. Pipe lines shall be laid straight and in true alignment with the grade and location established on the drawings, or as directed by OWNER.
- E. Pipes passing through walls below grade and passing through sleeves shall be made watertight by sealing as specified or in an approved manner.
- F. In some cases, pipe shall pass through boxed out areas in slabs or walls, as shown on the Drawings.
- G. Pipes or tubing passing through or under building grade beams shall be installed in a Class 54 D.I. sleeve giving 4 in. clearance to prevent possible damage from settling of the building; sleeve shall extend one pipe diameter beyond plane of the grade beams in both directions.

3.03 Flushing Underground Systems

- A. Before backfilling and before connecting aboveground systems to the underground connections, all pipe, fittings, valves, etc., shall be cleaned of core sand, scale and other foreign matter.
- B. Underground piping shall be flushed with water at a velocity of at least 6 ft. per second for a fifteen (15) minute period, or until all dirt and debris are thoroughly flushed out.

3.04 Aboveground Piping Installation-All Services

- A. General:
 - 1. Pipe lines aboveground shall be run parallel with the lines of the building unless otherwise shown or noted on the drawings. All horizontal runs of piping shall be kept as high as possible so as to provide maximum head room. Vertical lines shall be kept as close to the columns or walls as possible. Pipe lines shall be run so as not to interfere with ducts, conduits or apparatus and with approved offsets around columns, beams and other obstructions, and with necessary expansion joints, pipe bends or fitting offsets, as may be indicated on the drawings or required as essential to an approved installation.
 - 2. Pipe ends shall be reamed. Care shall be taken at all times to prevent foreign material from entering any pipe.
 - 3. Threaded coupling shall be made using an approved teflon tape on the male end. Care shall be taken to prevent the tape from reaching the pipe interior.
 - 4. Horizontal lines shall pitch to low points to provide for complete drainage of each system. Pitch, unless otherwise shown on the drawings shall be not less than 1 inch in 40 feet against direction of flow. Air vents shall be installed at all high points and at locations where air may pocket on all water lines. Air vents shall be drained to sewers or suitable receivers. Hot water heating, gas and air lines shall pitch as stated, but in direction of flow.
 - 5. Gaseous piping connections to equipment shall be valved and where practical shall be taken off the top of the main or sub-main.

6. Structural steel shall not be cut burned or welded to aid in piping installation except with written approval of OWNER.

B. Placement of Valves:

1. Valves shall be installed at all service connections to equipment, branch lines from main lines, at low points for draining each system and as shown on the drawings.
2. Chain wheel operators shall be provided for all valves located 7'-0" or more above floor surfaces.

C. Piping Hangers and Supports:

1. Piping shall be adequately supported by means of hangers and supports. Overhead lines shall be carried directly on supports or suspended by clevis hangers from supports. Support steel, hangers, etc., shall be furnished and installed. Piping at all equipment, control valves, etc., shall be supported so that equipment, valves, etc., can be removed without further supporting the piping. Additional support for valves installed in fiberglass and PVC pipe lines shall be provided as required. Piping shall not introduce any strains or distortion to the connected equipment.
2. Spacing of supports for horizontal piping shall be no greater than shown on the following schedule or as detailed on the drawings:

<u>Steel; SS Pipe; D.I.</u>	<u>Support Spacing</u>	<u>Copper Pipe</u>	<u>Support Bracing</u>
1/2" & smaller	7'-0"	1/2"	6'-0"
3/4" - 1"	8'-0"	3/4" - 1"	8'-0"
1-1/4" - 1-1/2"	9'-0"	1-1/2" - 2"	10'-0"
2"	10'-0"	2-1/2" - 5"	12'-0"
2-1/2" - 3-1/2"	12'-0"	6" & larger	14'-0"
4" - 5"	14'-0"		
6"	16'-0"		
8" - 12"	20'-0"		

<u>Fiberglass Pipe</u>	<u>Support Spacing</u>	<u>PVC & Poly- Propylene Pipe</u>	<u>Support Bracing</u>
2"	7'-0"	1/2" - 3/4"	3'-0"
3"	7'-6"	1" - 1-1/2"	3'-6"
4"	8'-0"	2"	4'-0"
6"	9'-0"	2-1/2" - 3"	4'-6"
8"	10'-0"	4"	5'-0"
10"	11'-0"	6"	6'-0"
12"	12'-0"		
14" and larger	13'-0"		

3. Cast iron soil pipe shall be supported close to hubs. A minimum of one support shall be used for each pipe length.
4. Cast iron and ductile iron pipe shall be supported at each joint or at 12'-0" maximum centers, whichever is closer.

5. Hanger rods used in conjunction with clevis hangers shall be sized as indicated in the following schedule. Rods shall be cold rolled steel. Rods installed in below grade galleries, in wet wells, or within retention structure shall be stainless steel.

<u>Pipe Size</u>	<u>Hanger Rod Dia.</u>
1/2" - 2"	3/8"
2-1/2" - 3-1/2"	1/2"
4" - 5"	5/8"
6"	3/4"
8" - 12"	7/8"
14" - 18"	1"

6. Stainless steel piping shall be supported with stainless steel brackets and hardware.
7. Trapeze hangers with U-Bolt type fastening may be used in lieu of clevis hangers in congested areas.
8. "Unistrut" used to support piping shall be Series P1000, galvanized, as manufactured by the Unistrut Products Co., Super Strut A-1200, Power Strut PS-200, or equal.
9. Risers shall be supported at intermediate points as required for rigidity.
10. Vertical piping shall be supported at its base by a hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation.
11. Hanger rods shall be connected to beam clamps, concrete inserts, or expansion shields. These devices shall be Underwriter's Laboratories approved. C-clamps will not be allowed.
12. Inserts shall be used for suspending hangers from concrete. Cadmium coated or galvanized inserts shall be used where galvanized hangers are required. Other means of setting anchors must be approved by the OWNER.
13. Perforated band iron or wire hangers shall not be used.
14. Clevis type pipe hangers shall be adjustable wrought steel. Grinnel Figure No. 260, Fee and Mason Fig. 239, Carpenter and Patterson Fig. 100, or equal, complete with bolts, rods and nuts.
15. Beam clamps shall be malleable iron with bolt, nut and pocket threaded for rod connection. Grinnel Fig. 229, or Elcen Fig. 95.
16. Dielectric separation material shall be incorporated into all supports if pipe material is different from support material.

D. Unions and Flanges:

1. Unions shall be provided at all valves up to 4" size, and at final connections to equipment, or apparatus. Sufficient joints shall be provided in piping systems to provide means of readily dismantling each system. Joints shall also be provided where shown on the drawings.

2. Unions shall be of the type, material and pressure rating as herein specified for the services involved. Unions for 4 in. pipe size and larger shall be made with gasketed companion flanges or grooved pipe couplings, as specified.
3. Unions for copper pipe shall be cast or wrought copper solder type pressure fittings of suitable size and end connections.
4. Unions and companion flanges shall be installed in the pipe lines at such locations as needed to permit the removal of fixtures, apparatus or equipment without dismantling. Unions and companion flanges shall not be installed in walls, ceilings, partitions or other inaccessible locations.
5. Wherever flanges with raised faces are joined to companion flanges with a flat face, the raised face shall be machined down to a smooth matching surface and a full-face gasket shall be used.

E. Reducer Fittings:

1. For proper drainage and air elimination eccentric type fittings shall be used when decrease in pipe size is necessary. Bushings shall not be permitted.
2. For water and other liquid lines top of pipe shall be installed on a continuous straight line.
3. For hot water heating, gas and air lines bottom of the pipe shall be installed on a continuous straight line.

F. Pipe Sleeves, Cover Plates & Flashings:

1. Pipe shall be provided with sleeves, flashings and plates shall be furnished, located and set for sections of the work where piping passes through floors, walls, ceilings or roof. Where sleeves pass through concrete construction, sleeves shall be located and set before concrete is poured.
2. Sleeves through concrete or masonry walls or floors shall be schedule 40 black steel pipe or molded non-metallic high-density polyethylene Model CS Century-Line sleeves as manufactured by CSI-Thunderline/Link-Seal or equal. Sleeves passing through walls or floors with water, earth or weather on one side shall be provided with 1/4-inch thick leakplates continuously welded to the sleeves at mid slab. Floor pipe sleeves shall extend 2" above floor surface. Space between pipe and exterior sleeves shall be sealed so as to provide air tightness for above ground installations and water tightness for below grade installations. Sealing medium shall consist of synthetic rubber links, corrosion resistant pressure plates and 316 Stainless Steel bolts as manufactured by PSI-Thunderline/Link-Seal. Caulking or other type mastic sealants or lead oakum joints are not acceptable.
3. Sleeves shall be of sufficient diameter to allow for pipe insulation and its jacketing, where insulation is required.
4. Piping extending into finished areas of the building shall have chrome plated floor, wall or ceiling plates, large enough to cover the pipe sleeves.

G. Pipe Welding:

1. Pipe welding may be by either oxy-acetylene or arc method, and shall be done by approved welders, qualified in accordance with accepted "Welder Qualifications and Procedures". Welding procedures and joint quality shall strictly conform to above procedures. OWNER reserves the right to require qualifying demonstrations at the mechanical CONTRACTOR's expense, of any welders assigned to the job.
2. Tee connections in welded piping shall be made with a factory fabricated butt welding tee or with Weld-o-let of butt, socket or threaded type. When Weld-o-lets are used, the size of the branch connection shall be one-half the diameter of the main or less. Scarf welding or direct butt welding of side connections shall not be permitted. Tees fabricated from pipe shall not be permitted.
3. Long radius welding ells, shall, whenever possible, be used in changing pipe directions of welded pipe lines. Mitered joints shall not be used unless approved by OWNER.

3.05 Pipe Saddles for Insulated Piping (General)

- A. For installations where the supported weight of the pipe is sufficient to distort the pipe insulation with the shield in place, hard wood blocking shall be installed against the pipe. Wood blocking shall be the same thickness as the insulation and shall be paraffin coated. Wood blocking shall be B-Line Systems Fig. B3169, Elcen Fig. 216 or equal. Vapor barrier shall be installed over the wood blocking to maintain the integrity of the system.

3.06 Miscellaneous Iron Work

- A. Structural supports, platforms, braces or tie rods required to support or hang piping and mechanical equipment without vibration shall be furnished and installed as required or directed by OWNER.

3.07 Shop Priming Procedures

- A. Unless specified otherwise, ferrous metal items, except items to be encased in concrete and areas adjacent to field welds shall be thoroughly cleaned and prime painted as described in Section 09 9000.

3.08 Protection/Cleaning of Piping and Equipment Systems

- A. It shall be the responsibility of CONTRACTOR to install and maintain pipe and equipment which is reasonably clean and free from rust, dirt, scale, etc. Where necessary, CONTRACTOR shall provide temporary airtight covers at all pipe and equipment openings.

End of Section

Section 40 0519

Ductile Iron Process Pipe

Part 1 General

1.01 Summary of Work

- A. Furnish all labor, materials, tools, equipment, testing, and supervision required to complete all piping systems, as indicated on the drawings and specified herein, and all other work incidental thereto, except as otherwise noted.
- B. The requirements of Section 11 0500, Common Work Results for Equipment, and Section 40 0505, Exposed Piping Installation, form a part of this Section and govern work covered in this Section.

1.02 Related Work

- A. Section 01 3300: Submittal Procedures
- B. Section 09 1000 Piping Identification
- C. Section 09 9000: Painting and Coating
- D. Section 40 0505: Exposed Piping Installation
- E. Section 40 0552: Process Valves and Actuators

1.03 Submittals

- A. Shop drawings are required for each item in this section of the specifications, including, but not limited to piping, couplings, gaskets, fittings, layouts, dimensions, etc. in accordance with Section 01 3300, Submittal Procedures.
- B. Pressure Test Reports.

1.04 Delivery, Storage, And Protection

- A. Properly store, protect, and handle all pipe per manufacturer recommendations.

Part 2 Products

2.01 Piping Materials

- A. Various types of piping materials are used to meet the specific requirements of the different piping systems as indicated in the "Piping Systems Schedule." This schedule shall be followed except that where a particular piping material is chosen for a piping system that material alone shall be used throughout that entire system of pipe and fittings, except as noted otherwise on the drawings.
- B. Flanges or grooved couplings shall be installed at connections to all equipment and valves 3 inches and over.
- C. Unions or grooved couplings shall be installed at connections to all equipment and valves 2 inches and below.

2.02 Above Grade Ductile Iron Pipe (D.I.)

- A. Ductile iron pipe and fittings shall be standard cement lined and shall meet the requirements of the current ANSI A21.15, (AWWA C115), "Ductile-Iron Pipe, Centrifugal Cast in Metal Molds or Sandlined Molds, for Water or other Liquids," and ANSI A21.10 (AWWA C110) "Ductile Iron and Gray Iron Fittings 3" through 48" for water and other

liquids. Cement lining shall conform to ANSI 21.4 (AWWA C104) requirements. Compact Fittings are not acceptable, except as otherwise specified herein.

- B. The minimum pipe thickness shall be Class 53.
- C. Flanged joints for above-grade piping shall be in conformity with the current ANSI B16.1, "Cast Iron Pipe Flanges and Flanged Fittings," Class 125. Non-Threaded mechanical flange fittings are not allowed.
- D. Bolts for all pipe materials shall be cadmium plated or hot-dipped galvanized unless otherwise specified. All bolts shall be coated with anti-seize compound prior to assembly.
- E. Gaskets for D.I. pipe shall be full face type made of minimum 1/8-inch-thick nitrile with a durometer hardness of 55 to 65 and shall conform to ANSI/AWWA A21.11/C 111 requirements unless otherwise specified. Gaskets for blind flanges shall cover the full face of the blind flange. Gaskets shall be as manufactured by Manville, Garlock or equal.
- F. Grooved Pipe Couplings:
 - 1. Grooved couplings for ductile iron pipe shall be Victaulic Style 31, or equal, with Grade "S" gaskets and grooves cut for rigid joints.
 - 2. Grooved fittings for ductile iron pipe shall be Victaulic with rigid grooves conforming to ANSI/AWWA C-606.
 - 3. Couplings shall engage the grooved pipe around the entire circumference, and bolt together with two or more track head bolts. All bolts and nuts shall be cadmium or zinc plated except inside the wet well or corrosive areas where they shall be 316 SS.
- G. Joints for above grade piping shall be flanged or grooved pipe couplings. In general pipe connections to valves or equipment shall be flanged unless otherwise indicated on the Drawings.
- H. Flanged Coupling Adapters:
 - 1. Flanged coupling adapters shall be of the restrained type and shall be of ASTM A536 ductile iron construction with fusion bonded epoxy coating for the gasket ring. The restraining system shall consist of individually actuated gripping wedges with torque limiting actuating screws. Flange coupling adapters shall be Series 2100 Megaflange manufactured by EBAA Iron, Inc

2.03 Below Grade Ductile Iron Pipe (D.I.)

- A. Ductile iron pipe below grade shall be Class 54 and shall conform to ANSI/AWWA C151/A21.51-02 with standard cement lining. Cement lining shall conform to ANSI 21.4 (AWWA C104) requirements.
- B. Pipe joints for below grade shall be restrained push on type or mechanical joints with retainer type glands. Retainer glands shall be Series 1100 Megalug as manufactured by EbAA Iron Sales, Inc. Bolts shall be protected from corrosion by coating with Bitumastic No. 50 or cement mortar to a minimum thickness of one inch.
- C. Polyethylene wrap shall be installed on all pipes except concrete encased pipes. The polyethylene wrap shall be cross-laminated high density and manufactured of virgin polyethylene material conforming to the requirements of ASTM A-674-00. Raw

materials used for the film, its strength, thickness, tube size, or sheet width must conform to ANSI/AWWA C105/A21.5.99.

- D. Bends, tees, wyes and other special fittings shall be cast iron Class 250 conforming to ANSI/AWWA C110/A21.10-98 or ductile iron Class 350 conforming to AWWA C153/A21.53-00 with standard cement lining.

2.04 Bolted Flexible Couplings

- A. Bolted flexible couplings shall be Style 38, Dresser Couplings with plain grade 42 gaskets, or equal. All bolted flexible couplings on pressurized lines installed above grade shall be provided with restraining rods designed to resist the test pressure of the piping system.

2.05 Flexible Pipe Connectors

- A. Provide flexible connectors on inlet and outlet piping to the air blowers and as shown on the Drawings. Existing flexible coupling from the two existing blowers made by re-used.
- B. Connectors shall have one-arch synthetic rubber construction with integral 150 lb. flanged ends. Units shall be rated for temperatures up to 230° F at 65 psi.
- C. Connectors shall be Mercer spool type 100 HT, Red Valve, Proco, or equal.

Part 3 Execution

3.01 Installation

- A. Pipe and fittings shall be installed according to Section 40 0505, Exposed Piping Installation, and per manufacturer recommendations.
- B. Flanges shall be used at connections to all equipment. Where screwed ends are present, a union shall be installed.
- C. Ductile Iron Pipe:
 - 1. Flanges shall not be assembled in the field.
 - 2. The flanges shall be power assembled and screwed tight on the pipe until pipe ends project beyond the face line of the flange. The face of the flange and the end of the pipe shall be machine finished to the same plane and normal to the pipe centerline. The flange hub shall completely cover the threaded portion of the pipe so that the machined surface of the pipe is protected against corrosion. After assembly to the pipe, bolt holes shall be drilled. The holes shall accurately straddle pipe and fittings centerline. Drilled holes for flanges shall be spot faced on the back of the flanges. All flange faces shall be machined to a smoothness of not less than 125 rms.
- D. Coated Steel Pipe Joints:
 - 1. Joints shall be primed and taped per the coating manufacturer's recommendation. Piping shall be handled with rope or burlap slings. No metallic pipe handling equipment shall be allowed. Trenches shall be backfilled with sand. No stones shall be allowed in the backfill material. The pipe during manufacturing, upon delivery and after placement, shall be subject to inspection and testing. The coating shall be as manufactured by Standard Pipe Protection or equal.

3.02 Prevention of Electrolysis

- A. Insulating couplings shall be provided at all joints between piping systems constructed of dissimilar metals.

3.03 Pressure Tests

- A. Piping shall be hydrostatically pressure tested according to Section 40 0505, Exposed Piping Installation.

3.04 Disinfection of Domestic Water Piping System

- A. Disinfect potable water distribution system in accordance with Section 33 0130, Water Utility Leak Testing and Disinfection.

3.05 Painting

- A. Ductile, Cast Iron, Carbon Steel, Copper and Plastic pipe shall be painted according to Section 09 9000, Painting and Coating, of these specifications.
- B. Stainless steel pipe and tubing shall not be painted.
- C. The following schedule shall be used for painting items specified herein:

Item	Painting System No.
Exterior ferrous piping	1
Interior ferrous piping (not specified elsewhere)	2
Submerged and non-submerged ferrous piping, brackets, and structures in corrosive areas	6

3.06 Piping System Schedule (P Sheets)

Piping System	Materials
Air Air (S)	STL. & SS SS
Wastewater and Sludge	D.I.
Water Main (E) & potable water	Copper
Water Main (B)	D.I.

Notes:

1. B - Below Grade; E - Exposed; S-Submerged
2. Piping shall be tested in accordance with local Plumbing Codes and certified.
3. Refer to Section 15400 for miscellaneous plumbing system piping materials.

End of Section

Section 40 0552

Process Valves and Actuators

Part 1 General

1.01 Summary of Work

- A. Furnish labor, materials, tools, equipment, and supervision required to complete valve installations as indicated on the Drawings and specified herein, and other work incidental thereto, except as otherwise noted.

1.02 System Description

- A. Valves and operators shall be of the type and size indicated on the Valve Schedule shown on the Drawings or included herein.
- B. Valves of the same type shall be of the same make, and when appropriate, the same model.

1.03 Submittals

- A. Shop drawings and Operation and Maintenance Manuals, as specified in Section 01 7700, are required for each item in this Section of the specifications, including, but not limited to valves, actuators, manual operators, pneumatic cylinders, flushing monitors, etc.

1.04 Warranty

- A. Warranty period for all items covered by this Section of the Specifications, except electric actuators, shall be two years from the date of equipment start up as specified in the Section 00 7200. Electric actuators shall be warranted against defects in workmanship and material as specified hereinafter.

Part 2 Products

2.01 Check Valves

- A. Check valves 6" and larger shall be flanged, 125 psig, swing type. Valves shall have cast iron bodies and discs, stainless steel disc shaft and Buna-N disc seat. Valves shall be complete with outside lever and spring suitable for vertical or horizontal service and shall be Clow Figure 1106SL, or Golden Anderson Figure 230 or ENGINEER-approved equal.
- B. Check valves 2" to 6" in size shall be flanged, 125 psig, swing type, cast iron body and disc complete with outside lever and weight unless otherwise specified. Discs shall be Buna-N faced. Valves shall be suitable for vertical or horizontal service. Valves shall be Clow Figure 1106LW, Golden Anderson Figure 220, Apco 250LW ENGINEER-approved equal.
- C. Duckbill check valves shall be low head loss valves of the type to be installed between flanged pipes. The valve shall be made of neoprene. The valve must meet ANSI Standard 61. Valves shall be Cla-Val RF-DBI-LH or ENGINEER-approved equal.
- D. Check valves for potable water, compressed air, industrial water, non-potable water, effluent water, etc. 3" diameter and smaller shall be screwed, regrindable swing type, 200 lb. bronze, Hammond IB944, Jenkins Model 762C, Stockham Model B-345, or ENGINEER-approved equal.

- E. Ball check valves for plastic piping systems shall be of polyvinyl chloride construction, 150 psi rating, screwed union body with socket weld ends and Viton "O" ring seals unless otherwise specified. Valves shall be as manufactured by Nibco, Hayward, Colonial Valve, or ENGINEER-approved equal.

2.02 Vacuum Breaker/Air Release Valves

- A. The valve body and cover for all vacuum breaker/air release valves shall be constructed of ductile iron. The float, spring, and lever shall be stainless steel. Valves shall be Cla-Val Series 38VB/AR or ENGINEER-approved equal.

2.03 Knife Gate Valves

- A. Knife gate valves shall be the single-seated, wafer type with through bolting designed to fit between ANSI B16.1 Class 125 flanges of the scheduled size. Wetted parts shall be 304 stainless steel unless otherwise listed on Valve Schedule or noted below. Valve pressure rating shall be 150 psi unless otherwise noted on Schedule.
- B. Valve stem shall be 304 stainless steel. Stem nut shall be acid resistant bronze mounted in the steel yoke.
- C. Valve gate shall be 304 stainless steel, beveled to provide a wedging action to seal the gate against the seat and to aid in cutting through any accumulated solids and shall be finished on both sides to 32 rms. Gate shall seal against a stainless steel seat with a neoprene O-ring integrally mounted therein to aid in providing a positive seal.
- D. Packing shall be TFE/graphite, mounted around the stem on top of the bonnet. It shall be held in place by a carbon steel follower. Packing shall be replaceable without disassembling the bonnet.
- E. A graphite wiper assembly shall be mounted between the gate and the valve body to prevent solids from entering the bonnet housing.
- F. Valves shall be provided with one spare set of stem packing and shall be clearly marked to indicate the seat side of the valve.
- G. Knife gate valves shall be Orbinox, or ENGINEER-approved equal.

2.04 Resilient Seated Gate Valves

- A. Materials: Except as modified or supplemented herein, materials used in the manufacture of resilient-seated gate valves shall conform to the requirements of ANSI/AWWA C509.
- B. Bronze Components: Bronze valve components in contact with liquid shall contain less than 15 percent zinc. Aluminum bronze components in contact with liquid shall be heat treated.
- C. Gaskets: Gaskets shall be free of asbestos and corrosive ingredients.
- D. Shop Coatings: Coatings shall conform to Section 09 9000.
- E. Valve Construction:
 - 1. Body: Valve shall be fabricated of ductile iron.
 - 2. Ends:

- a. Valve ends shall be compatible with connecting piping. Except as modified or supplemented herein, the ends shall conform to the applicable requirements of ANSI/AWWA C509.
- b. Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch (125 μ m). The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.001 inch per inch (1 μ m/mm) of flange diameter.
- c. Flanges shall be drilled, and spot faced per ANSI B16.1, Class 125.
- 3. Stem Seals: Stuffing box stem seals shall be provided for all gate valves with rising stems (outside screw-and-yoke type). O-ring stem seals shall be provided for all buried gate valves, and for all gate valves with non-rising stems.
- 4. Rotation: Direction of rotation of the handwheel or the wrench nut to open the valve shall be to the left (counterclockwise).

2.05 Operators

A. Wrench Nut (WN):

- 1. Wrench nut operators shall be provided, as indicated in the "Valve Schedule" and shall be 2-inch square nut for operation by a T-handle wrench. Wrench nuts shall be provided with a cast iron valve box.

B. Lever Operators (L):

- 1. Lever operators shall be provided, as indicated in the "Valve Schedule".
- 2. Lever operators shall be of suitable length and material for the operation of the valve by one man with a pull of not more than 30 lbs.

C. Gear Operators (G):

- 1. Gear operators shall be provided for all manually operated valves to ensure that the maximum force required for opening via wrench nut or handwheel is 30 lbs.
- 2. Gear mechanism shall be the totally enclosed type, totally sealed for submersible installation.
- 3. Gear operator shall be selected to operate the valve at the indicated test pressure on the Piping Schedule.
- 4. Operators for buried or submerged valves shall be sealed and specifically designed for buried/submersed service, including those operators in the clearwell and settling basins.
- 5. Operating shaft to be supported axially and radially at the input end by permanently lubricated thrust and sleeve bearings, the actuator shall be mounted to the valve with stainless bolting.

D. Handwheel Operators (HW):

- 1. Handwheel operators shall be provided as indicated in the Valve Schedule and shall be of the valve manufacturer's standard design. Handwheels shall operate with 40 lbs. maximum applied force, with the test pressure indicated on the Piping Schedule applied across the valve.

E. Electric Actuators (EM, EMR, EMS, EMX):

1. Valves or gates where called for on the Drawings or indicated in the valve schedule, shall be furnished with electric motor operators.
2. Each motorized operator shall consist of a motor operator, unit gearing, limit contacts, torque switches, terminal strips, gear case, stem nut, stem cover, control cabinet, reversing magnetic starter, push button control, indicator lights, shop wiring, and all other accessories required to provide satisfactory operation. A handwheel for operation in case of power failure shall also be provided.
3. Valve operators shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The time to operate any valve from full open to full closed shall not exceed 2 minutes for quarter turn valves, or the operating speed shall be not less than 12" (min.) for gates.
4. Each valve operator shall be designed to operate the valve from and/or to any intermediate position and shall be of sufficient size and rating to open and close the valve under any condition of operation.
5. Two sets of limit switch contacts shall be provided for remote indication of valve or gate position (open, closed). Two field programmable contacts and auxiliary contacts for monitor relay shall be included.
6. Unless specified otherwise herein, power to each operator shall be 460-volt, 3 phase, 60 Hz., (unless indicated otherwise on the valve schedule) and all electrical enclosures shall be NEMA Type 4 watertight, suitable for outdoor installation. Each operator housing shall be of ductile iron or die cast aluminum construction.
7. Modulating Service:
 - a. When modulating service is specified, the actuator shall respond to a control signal as indicated on the Drawings. The package shall include solid state starter, control transformer, local controls, indicating lights and position indicator. Valve shall be capable of being stopped in any intermediate position.
 - b. The operator shall be rated for at least 60 starts per hour, and a minimum accuracy of plus or minus one percent.
8. Quarter Turn Movement:
 - a. Valves 8" diameter and larger which require 90° movement (quarter turn valves) shall be provided with Model IQ/90° worm gear, AWWA C504 valve actuators, as manufactured by Rotork (gear actuators shall be suitable for occasional submergence when used with actuators designed for submergence as indicated in the valve schedule).
 - b. Valves 6" diameter and smaller which require 90° movement (quarter turn valves) shall be provided with Model AQ, as manufactured by Rotork. Power to these actuators shall be 120V, single phase. Other

requirements previously noted regarding service and duty ratings in paragraph 2.16 E.1.d shall apply to these actuators.

9. Manufacturer:

- a. Rotork Model IQ/Bevel Gear or ENGINEER-approved equal.

10. Warranty:

- a. Electric actuators shall be warranted against defects in workmanship and material for a period of five (5) years from the date of acceptance.

F. Valve Operator Accessories:

1. General:

- a. Where indicated in the valve schedule and/or on the Drawings, extension stems with bronze bushed stem guides spaced as required, floorstands, valve boxes, gearing, handwheel, chainwheels and chains, lever, etc., shall be provided. Valve operator accessories shall be as follows:

- (1) Extension Stems: Type 304 S.S.
- (2) Couplings: Bronze or Stainless Steel
- (3) Chains: Galvanized Steel
- (4) Valve Boxes: C.I. with 8" clear opening and removable cover
- (5) Operating Nuts: 2" square cast iron
- (6) Floor Stands: Fabricated steel or cast iron

2. Floorstands/Neck Extensions:

- a. Valves shall be provided with floorstands whenever indicated in the valve schedule or on the Drawings.
- b. Manually operated floor stands will be right angle crank or handwheel type as indicated in the valve schedule or called for on the Drawings.
- c. Each floor stand shall be provided with a threaded stem. Tapered roller bearings or ball bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts. Bench stands shall operate under the specified operating head with not greater than a 40 lb. pull on the crank or handwheel. Gears shall be steel with machine cut teeth. Pinion shafts shall be supported on tapered bearings. components shall be totally enclosed in a cast iron case and cover. Positive mechanical seals shall be provided on the operating nut to exclude moisture and dirt and prevent leakage of lubricant. Lubricating fittings shall be provided for the lubrication of all bearings.
- d. Removable cranks and handwheels shall be designed for rough treatment and minimum weight. An arrow with the word "open" shall be permanently attached or cast on the floor stand indicating the direction of rotation to open the gate.
- e. Neck extensions shall be supplied by the valve manufacturer, they shall be designed to seal the neck of the valve and support the actuator properly when actuated. Outer support piping shall not require external supports under 15-foot lengths. Inner pipe shall be sized not to twist and shall include any supports required within the outer pipe to allow

full operation of the disc and allow the actuator to hold any mid-travel position without fluttering. The neck extension shall be stainless steel.

3. Limit Switches (LS):

- a. Limit switches shall be provided on valves as indicated in the valve schedule or on the Drawings. Limit switches shall be NEMA Type 4, single pole, double throw type, cam-operated, adjustable throughout travel range and rated at 10A for 120/240 V service.
- b. Two limit switches which provide overlapping open and close dry contacts for remote monitoring shall be provided for each valve so designated.

4. Position Indicators (PI):

- a. Visual valve position indicators shall be provided on all modulating valves and shall be model BM3-5 as manufactured by Westlock Controls Corp.

Part 3 Execution

3.01 Installation

- A. Piping and valve installation shall be as specified in other applicable sections of these specifications.

3.02 Tests

- A. Motor, pneumatic, hydraulic and solenoid operated valves shall be field tested. Field testing shall include local and remote operation and all alarm functions (if applicable).
- B. Automatically operating valves shall be adjusted to the set points specified or those identified by ENGINEER. Testing shall then be conducted to verify operation including any alarm functions.

3.03 Manufacturer's Field Service

- A. A factory representative employed by the manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment and to instruct OWNER's operating personnel in the maintenance and operation of these units. The scheduling of this service shall be coordinated with OWNER and the cost of this service shall be included in CONTRACTOR's bid price.
- B. Operation and maintenance training shall be provided for each type of actuator, unless otherwise specified.

3.04 Painting

- A. The following schedule shall be used for painting items specified herein:

Painting Item	System No.
Exterior, Valves & Operators	1
Interior, Valves & Operators (not specified elsewhere)	2

- B. For detailed painting requirements and system descriptions refer to Section 09 9000.

3.05 Storage of Material

- A. Material shall be stored prior to installation in accordance with Sections 01 6000, and the manufacturer's instructions. Valve actuators shall be stored in a manner to prevent damage due to moisture or water intrusion.
- B. Conduits connected to valve actuators shall be temporarily sealed during construction to prevent water entrance through open conduit systems.

End of Section

Section 40 6300 Instrumentation and Controls

Part 1 General

1.01 Description

- A. This Section includes the design, fabrication and installation of the various instrumentation and control elements and systems required for this facility, whether supplied under this Section or with equipment furnished under other Sections of these Specifications. Control systems and components are shown on the drawings using programmable controllers. However, manual controls and emergency float control schemes for the pump systems shall be hardwired with relays where shown on the drawings.

1.02 Related Work Specified Elsewhere

- A. Section 26 0500: Electrical General Requirements
- B. Section 26 0510: Basic Electrical Materials and Methods

1.03 Definitions

- A. The P & ID Drawing Legend Sheet of the Contract Drawings gives the Instrument Society of America's code and definitions of instruments and devices shown on the P & I Drawings in the Contract Drawings and used in the specifications.

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. AWWA - American Water Works Association
 - 2. FM - Factory Mutual Insurance Underwriters
 - 3. ISA - Instrument Society of America
 - 4. JIC - Joint Industrial Council
 - 5. NEMA - National Electrical Manufacturers Association

1.05 Contractor's Verification

- A. CONTRACTOR shall provide written verification that all equipment, materials and components are designed for the operations specified herein and are free from any defects in workmanship and not previously installed or otherwise used.

1.06 Submittals

- A. Shop Drawings:
 - 1. Submit operating and maintenance instructions of all instrumentation and control components and equipment in accordance with Section 01 3300 Submittals, and Section 26 0500, Electrical General Requirements.
- B. Operation and Maintenance Data:
 - 1. Submit operating and maintenance instructions of all instrumentation and control components and equipment in accordance with Section 01 3300 Submittals, and Section 26 0500, Electrical General Requirements.

Part 2 Products

2.01 Equipment

- A. This Specification describes the "minimum requirements" of the instrumentation and controls and includes the special features required for each.
- B. This Specification describes the "minimum requirements" of the Instrumentation and Control hardware required for this Project. Any deviations from this Specification shall be considered not acceptable. See P & I diagrams in Contract Drawings.
- C. Vertical Scale Indicators:
- | | |
|----------------------|---|
| Function: | Provide indication of process variables |
| Type: | Vertical scale |
| Input: | 4 to 20 mADC |
| Terminal Resistance: | 5 ohms maximum |
| Accuracy: | 2.0% upper range value |
| Repeatability: | 1.0% upper range value |
| Zero: | External screw adjustment |
| Scale Length: | Not less than five inches |
- D. Miniature Strip Chart Recorder:
- | | |
|--------------------|--|
| Function: | Provide permanent time record of process variables |
| Type: | Electronic circuitry with mechanical pen arms |
| Input: | Electronic circuitry with mechanical pen arms |
| Accuracy: | 0.5% of span |
| Repeatability: | 0.25% of span |
| Deadband: | 0.75% of span |
| Pen Response: | No greater than 5 seconds, full scale |
| Chart Drive: | 120 VAC drive, 16-day, suitable for scan fold charts |
| Power Consumption: | Not to exceed 14.2 watts |
- E. Linear Integrators:
- | | |
|-------------------------|-------------------------------------|
| Function: | Convert analog signal to pulse rate |
| Type: | Electronic |
| Input Signal: | 4 to 20 mADC into 50 ohms |
| Output Signal: | 24 VDC, 35 millisecond pulse |
| Power Supply: | 117 VAC, 60 HZ |
| Repeatability: | 0.01% span |
| Calibration Capability: | ±0.05% span |
| Count Dropout: | Adjustable 1 to 20% span |
| Span Adjustments: | 22 turn potentiometer on face |
| Zero Adjustments: | 22 turn potentiometer on face |
| Power Consumption: | 5 watts nominal |
| Manufacturer: | Moore Industries, Adtech; or equal |
- F. Electronic Totalizers:
- | | |
|---------------|--|
| Function: | Display totalized flows |
| Type: | Electronic (electro-mechanical not acceptable) |
| Input Signal: | 24 VDC, 35 millisecond pulse |
| Output: | Visual 8-digit LED display |
| Options: | Provide battery charger and battery |

G. Float Switches:

Function:	Provide discrete level measurement
Operation:	Changes in level causing tilt in float activating switch
Float Material:	316 stainless steel, teflon
Float Diameter:	5.5 inch diameter
Cable:	Length as required; Type SO Nitril PVC jacketed with 3
No.	14 AWG stranded conductors
Switch Rating:	10 amps at 115 VAC
Warranty:	3-year factory warranty

H. Intrinsically Safe Relay:

Function:	Interface control in explosive atmospheres
Type:	Solid state electronic
Input Signal Value:	Less than 1 ma @ 9.6 VDC
Output Signal Value:	Contact closure - 10 amp resistive rated 2 N.O. + 2 N.C. independent and isolated
Power Supply:	120 V - 1 PH - 60 HZ
Power Consumption:	6 watts or 9 V.A.
Power Terminals:	Plug-in quick connect tabs
Housing Panel:	NEMA 7 compartment with barrier inside
Approval:	FM
Sensitivity Adjust:	10,000 ohm to 1 megohm

I. Electronic Dual Current Switch:

Function:	Monitor input signal and trip at set point
Type:	Direct current switch suitable for panel mounting
Input:	4 to 20 M
Output:	DPDT relay contacts rated 5 A at 117 VAC noninductive
Power:	117 VAC 50/60 HZ $\pm$ 10%
Manufacturer:	Adtech, or equal

J. Pilot Indicating Light (Push Button Station):

Function:	Visual indication of control function
Type:	Heavy-duty; oil-tight or weatherproof as required; full voltage; push-to-test
Input:	120 volts, 60 HZ
Color Cap:	Plastic
Color Designation:	Red - "Run" "Open" Green - "Close" "Stop" Amber - "Defined Status" "Overload" Blue - "Defined Status" White - "Defined Status" "Auto" "Power On" Clear - "Defined Status" "Ground"
Mounting:	(1) Push Button Stations Mounting hole 1-13/64" D Pilot hole 1/4" D Space between holes 9/16" minimum

- K. Pushbutton:
- Function: Manual operator control
- Type: Oil-tight or weatherproof, momentary or maintained contact as required; emergency stop shall be maintained,
- Contacts: 1 N.O. and I.N.C. (minimum) Provide contact arrangements
- Rating: 10 amp @ 120 VAC continuous
- Mounting: (1) Push button station
- Operator: Extended head
- Start, open, close or run function - black operator
- Stop function - red operator
- Silence - green operator
- L. Alarm Horn:
- Function: Vibrating Alarm Horn
- Type: Weatherproof Grille type, corrosion resistant finish as required
- Application: See Contract Drawings
- Power Input: 120Vac
- db output: 103db at 10 feet.
- Manufacturer: Edwards Model # 876-N5
- M. Beacon:
- Function: Flashing Alarm Light
- Type: heavy duty inside and outside applications as required
- Application: See contract Drawings
- Input: 0.34 A
- Power Input: 130Vac
- Bulb: 40 watts
- Housing: NEMA 3
- Color: Re
- Manufacturer: Edwards Mode # 876-N5
- N. Surge Protective Device SPD:
- Function: Lightning Arrestor and surge suppressor
- Type: Heavy duty inside and outside applications as required
- Application: See Contract Drawings
- Voltage: 600 V
- Short Circuit current: 200kA
- Bulb: 40 watts
- Housing: NEMA 4X
- Manufacturer: SQUARE-D Model# SDSA3650

O. Phase Monitor:

Function:	Protects against phase loss and reversal
Type:	Heavy duty inside and outside applications as required
Application:	See Contract Drawings
Supply Voltage:	190-270V
Control Voltage:	171-243 Volts, 3phase
Current rating:	10A
Operating Temp:	0 to +55 °C
Phase Sequence:	ABC, will not operate on CBA
Manufacturer:	Diversified Model # SLA-230-ASA

P. Heater and Thermostat:

Function:	Heater and thermal management
Type:	Touch Safe IP20 heater
Application:	See contract Drawings
Rated voltage:	110Vac
Power Consumption:	20Watts
Nominal Current:	4.5 A
Housing:	UL-94V-0 black plastic housing
Mounting:	Vertical Mount, Mounting clip for 35mm Din rail,
EN60715	
Manufacturer:	Hoffman Model # DAH 2001B

Q. Selector Switch:

Function:	Manual control mode selection
Type:	Heavy-duty, Oil-tight or weatherproof, as required
Application:	See contract Drawings
Positions:	Two-three-four (as required)
Contacts:	Form a or Form b (as required) (Form c not acceptable)
Operator:	Knob level type
Contact Rating:	120 VAC-10 amp continuous (60 amp make - 6 amp break)
Mounting:	(1) Push button station mounting hole 1-13/16" D Pilot hole 1/4" D space between holes 9/16" minimum
Options:	(1) Spring return as required (2) Cylinder key lock as required

R. Differential Pressure Transducer/Transmitter:

Function:	Provide analog pressure measurement
Type:	Pressure transducer with 4-20 mA output proportional to system pressure
Housing:	NEMA 4
Fill Fluid:	Silicone Oil
Wetted Parts:	316L Stainless Steel
Range:	0 – 150 psi
Span:	0 – 40 feet
Output:	4 – 20 mA analog signal superimposed upon a HART protocol digital signal
Certification:	Factory Mutual (Class I, Division I)
Manufacturer:	Smar LD291 or approved equal

S. Gauge Pressure Transducer:

Function:	Provide discrete pressure measurement
Type:	Pressure transducer with 4-20 mA output proportional to system pressure
Housing:	NEMA 4
Range:	0 – 150 psi
Span:	Adjustable over 100% of range
Output:	4 – 20 mA
Manufacturer:	Johnson Yokogwa Model YA53-SCS4*A or equal

T. Current Switch:

Function:	Provide contact closure for specified current setpoint
Type:	Dual alarm direct current switch
Input:	4-20 mA
Output:	contact closure, 10 A, DPDT
Power Input:	115 VAC
Set Point:	Adjustable over 100% of range
Manufacturer:	Moore Industries Model DCA 14-20 mA or equal

U. Control Transformer

Function:	Control Transformer
Type:	Sealed Transformer
Phase:	Single Phase
Primary:	480V
Secondary:	240/120V
Enclosure:	NEMA 4X
Manufacturer:	SQUARE D Model# 4XS7S1FSS or equal

V. Power Supply

Function:	Provide 24 volt power for 4-20 mA pressure transmitter
Type:	Process power supply
Input:	115 VAC
Output:	24 VDC
Housing:	NEMA 12
Ripple:	No more than 50 mV peak to peak
Manufacturer:	Moore Industries Model PPS/24DC/200 mA or equal

W. Machine Tool Relays:

Function:	Relay logic
Type:	Heavy-duty plug in
Contact Arrangement:	3 P.DT, minimum
Construction:	Clear polycarbonate cover with epoxy encapsulated coil
Mounting:	11 pin terminal-type socket
Life:	20,000,000 operations

X. In-Line Flow Indicators:

Function: Locally monitor flow in-line
Type: Direct operated, signal generating
Flow: 1/2 to 9 gpm
Pressure: 200 psi
Construction: Body shall be brass, nylon bowl, internal moving parts of 304 SS, seals of ethylene propylene
Manufacturer: Universal Flow Monitors; or equal

Y. Telemetry:

1. CONTRACTOR shall provide and install a multi-input data transmission system to transmit critical alarms over voice grade telephone lines. Output from each receiver shall be a contact closure connected to the annunciator.

Transmitter:

Function: Transmit Audio Tone Telemetry over dedicated telephone data lines
Type: Electronic tone transmitter with multi-input scanner
Input: Contact closure (minimum of 6 inputs)
Output: Audio Tone, FSK, or Digital
Power Supply: 120 VAC, 1-phase, 60 HZ
Enclosure: NEMA 12
Programming: Via local RS 232C and remote modem
Manufacturer: QEI 1130 Series, Dorado 300 Series or equal

Receiver:

Function: Receive Audio Tone signal from the transmitter and energize output relay
Type: Electronic tone receiver with multi-point scanner and relay output
Input: Audio Tone, FSK, or Digital
Output: N.O. or N.C. relay contact per input point (minimum of 6 outputs)
Relay Contact Rating: 5 amp at 120 VAC resistive load
Power Supply: 120 VAC, 1-phase, 60 HZ
Enclosure: To be installed inside main control panel
Manufacturer: QEI 1130 Series, Dorado 300 Series or equal.

Transmitter:

Function: Transmit Digital and Audio Tone Telemetry over dedicated telephone data lines
Type: Electronic transmitter with multi-input scanner
Input: Contact closure (minimum of 6 inputs) and one 4-20 mA input
Output: Audio Tone, FSK, or Digital
Power Supply: 120 VAC, 1-phase, 60 HZ
Enclosure: NEMA 12
Comm. Interface: RS 232C local serial port
RJ 11C telephone connection built in modem
Digital voice
256 events with real time clock and calendar stamp
Programming: Via local RS 232C and remote modem
Manufacturer: Phonetics, Inc. model sensaphone or equal

Z. Elapsed Time Meters:

1. Elapsed Time Meters shall be provided and installed as shown.
2. ETM's shall be of the nonreset type and shall have a synchronous motor drive and digit readout wheels to indicate the total time the equipment has operated. The meters shall have six digits and will totalize to 99,999.9 hours. The meters shall have approximate dimensions of 3-inch square and shall be mounted on the front panel face.

AA. Event Recorder:

Function:	Record the time and duration of events of the connected equipment such as pump running, pump stopped, etc.
Type:	Continuous graphic event recorder; electronic circuitry with mechanical disposable inking pens.
Input:	10 channels, dry contact closure
Enclosure:	Wall mounted NEMA 1 panel
Chart Drive:	120 VAC synchronous motor and 60 day roll chart
Manufacturer:	Esterline Angus Model No. A620X or equal

2.02 Laser Level Measuring Device

A. Equipment to be furnished shall include:

1. Visible laser light optical level sensor
2. Measuring range shall be greater than or equal to 1 foot to 30 feet.
3. Cable shall be long enough to reach from the transducer to the meter enclosure

B. The sensor shall be required to perform the following:

1. Indicate the level locally
2. Provide an analog 4 – 20 mA output of level
3. Provide a local keypad for user selectable variables

C. The sensor shall be suitable for operation in an environment with temperatures ranging from 0 degrees F to 50 degrees F and relative humidity from 0 percent to 95 percent (non-condensing).

D. Assemblies:

1. The transducer assemblies and all electrical wiring for the wet well structure shall be suitable for Class 1, Division 2, Groups C and D hazardous locations.
2. The vertical positioning and angle of deflection of the laser shall be in accordance with the manufacturer's recommendations. All equipment, instrumentation elements, wiring, conduit, etc., are to be securely mounted and not be subject to damage by solids and debris. All signal, power wiring and conduit are to be securely mounted.

E. Level Meter:

1. The sensor and control electronics shall be enclosed in a NEMA 4 enclosure and capable of withstanding temperatures from 0 degrees C to 50 degrees C.

2. Complete programming of the sensor shall be capable from the controls. The level meter shall have a liquid crystal display to indicate level and to display program parameters.
 3. The transmitter shall output an analog 4 – 20 mA signal proportional to the level and or flow range.
- F. Cable:
1. CONTRACTOR shall furnish all cable and conduit between the transducers and the level meter. The cable shall be of the type specified by the level meter manufacturer. Any connectors to the transducers that may be required shall be supplied by the level meter manufacture. The transducer cable shall be long enough to reach from the transducer to the level meter. The Cable shall be continuous with no splices or connectors between the meter and the transducer.
- G. Acceptable Manufacturer:
1. The level sensors shall be manufactured by Efector IFM or ENGINEER approved equal.
- H. Installation:
1. The level meter shall be installed in accordance with the manufacturer's instructions. CONTRACTOR shall fabricate a bracket for attaching level as necessary in the following locations:
 - a. One sensor over each cake discharge location; three locations per trailer; two trailers; six sensors total

2.03 Ultrasonic Level Measuring Device

- A. Equipment to be furnished shall include:
1. Ultrasonic level meter in NEMA 4 wall mount enclosure.
 2. Ultrasonic level transducer capable of measuring depths to 60' deep.
 3. Transducer cable long enough to reach from the transducer to the meter enclosure.
- B. Provide multipurpose relays with one form "C" (SPDT) contact per relay, rated at 5 amps at 240 volts non-inductive.
- C. The ultrasonic level meter shall be required to perform the following:
1. Indicate the level locally
 2. Provide an analog 4 – 20 mA output of level.
 3. Provide a local keypad for user selectable variables.
- D. The level meter shall be suitable for operation in an environment with temperatures ranging from 0 degrees F to 50 degrees F and relative humidity from 0 percent to 95 percent (non-condensing).
- E. Transducer Assemblies:
1. The transducer assemblies and all electrical wiring for the wet well structure shall be suitable for Class 1, Division 2, Groups C and D hazardous locations.

2. The vertical positioning and angle of deflection of the sonic signal shall be in accordance with the manufacturer's recommendations. All equipment, instrumentation elements, wiring, conduit, etc., are to be securely mounted to the structure so as not to interfere with the sonic level signal or be subject to damage by solids and debris. All signal, power wiring and conduit are to be positioned along the sides of the wet well.

F. Level Meter:

1. The level meter electronics shall be enclosed in a NEMA 4 enclosure and capable of withstanding temperatures from 0 degrees C to 50 degrees C. The level meter shall be equipped with a removable keypad for programming. Complete programming of the level meter shall be capable from the keypad. The level meter shall have a liquid crystal display to indicate level and to display program parameters.
2. The transmitter shall output an analog 4 – 20 mA signal proportional to the level and or flow range. Five form "C" (SPDT) relays shall be programmable to energize at critical elevations.

G. Transducer Cable:

1. The CONTRACTOR shall furnish all cable and conduit between the transducers and the level meter. The cable shall be of the type specified by the level meter manufacturer. Any connectors to the transducers that may be required shall be supplied by the level meter manufacture. The transducer cable shall be long enough to reach from the transducer to the level meter. The Cable shall be continuous with no splices or connectors between the meter and the transducer.

H. Acceptable Manufacturer:

1. The level meters shall be HydroRanger as manufactured by Milltronics; or ENGINEER approved equal.

I. Installation:

1. The level meter shall be installed in accordance with the manufacturer's instructions. CONTRACTOR shall fabricate a bracket for attaching level as necessary. in the following locations:
2. One sensor in the polymer storage tank

J. Warranty:

1. CONTRACTOR shall repair or replace any part that fails due to defects in materials or workmanship within 30 days of being notified. Any equipment which is replaced due to defects in material or workmanship shall carry a new one-year manufacturer's warranty. All warranties shall be transferred to OWNER at project completion.

K. Calibration:

1. Upon installation of level meter, CONTRACTOR shall do a site calibration, input the data as appropriate, and compare the measured level with the level as calculated by the level meter. Level meter accuracy shall be within $\pm 0.5\%$. Any level meters that fail to calculate level within the $\pm 0.5\%$ accuracy shall be repaired, replaced, or adjusted as approved by the ENGINEER to meet the accuracy requirement.

2.04 **Level Measuring Device**

A. Transducer Assemblies:

1. Transducer assemblies and all electrical wiring for the wet well structure shall be suitable for Class 1, Division 2, Groups C and D hazardous locations.
2. Vertical positioning shall be in accordance with the manufacturer's recommendations. All equipment, instrumentation elements, wiring, conduit, etc., are to be securely mounted to the structure so as not to interfere with the transducer or be subject to damage by solids and debris. All signal, power wiring and conduit are to be positioned along the sides of the wet well.

B. Transducer Cable:

1. CONTRACTOR shall furnish all conduits between the transmitter and the transducer. The cable shall be supplied by manufacturer. Any connectors to the transducer that may be required shall be supplied by the manufacture. The transducer cable shall be long enough to reach from the transducer to the junction box. The Cable shall be buried (outside the well) in a separate conduit and shielded for correct operation of the level-sensing sensing device. The level transducer shall be manufactured by MultiTrode.

C. Installation:

1. Transducer shall be installed in accordance with the manufacturer's instructions.
2. Mounting Bracket Kit is supplied with the Multi sensor Probes.
3. Mounting Bracket Kit shall include a built-in integral squeegee for easy probe cleaning.

D. Level Transmitter:

1. Level meter electronics shall be enclosed in a NEMA 4 enclosure and capable of withstanding temperatures from 0 degrees C to 50 degrees C. The level meter shall be equipped with a removable keypad for programming. Complete programming of the level meter shall be capable from the keypad. The level meter shall have a liquid crystal display to indicate level and to display program parameters.
2. Transmitter shall output an analog 4 – 20 mA signal proportional to the level and or flow range. Five form "C" (SPDT) relays shall be programmable to energize at critical elevations.
3. Supply voltage shall be 24v DC and the power consumption shall not exceed 15Watts.

4. Operating temperature range shall be from + 14°F to 140°F. The transmitter shall be IP 20 rated for indoor use and the Display shall be rated at IP 65. The level Transmitter shall be manufactured by MultiTrode, model Multismart Pump station Manager.

2.05 Magnetic Flowmeters

A. Description:

1. This section encompasses the selection and installation of magnetic flowtube (FE) and flow transmitter indicator (FIT) as a complete system. The size of the meters and flow ranges shall be as shown on the drawings.
2. The magnetic flowmeter shall consist of a magnetic flowtube and a flow transmitter indicator.
3. The flow transmitter shall operate at 120 VAC and be housed in a remote mounted NEMA 4 enclosure. A flow indicator calibrated in GPM shall also be provided.
4. The flowmeter shall be suitable for operation in an environment with temperatures ranging from 0 degrees C to 50 degrees C and relative humidity from 0 percent to 95 percent (non-condensing) and shall be able to be submerged for a period of up to 48 hours.
5. All equipment shall be furnished by one supplier. Component devices which perform similar functions in each system shall be purchased from the same manufacturer. The CONTRACTOR shall remain responsible for the proper functioning of the entire project as a whole.
6. CONTRACTOR shall ensure that the selected magnetic flowtube and transmitter are compatible.
7. The magnetic flowmeter system shall be ABB (Fischer & Porter) MAG-XM series or approved equal.

B. Magnetic Flowtube:

1. The magnetic flow meter shall be of the DC type suitable for intended application, and shall be equipped with 316 stainless steel bullet-nose electrodes, copper magnetic coils, hard rubber lined flow tube with welded steel housing and ANSI Class 150 flanges on both ends, two liner protectors which serve as grounding rings and two ground straps. The flow tube shall be rated for accidental submergence.

C. Flow Transmitter Indicator:

1. The flow transmitter shall accept the millivolt signal from the magnetic flowmeter and convert the signal into a 4-20 mA linear flow signal as well as a scaled pulse output. Accuracy shall be +/- 1 percent of rate or 0.1 percent of full scale. The signal converter shall be solid state with range potentiometer, adjustable damping up to 90sec/full scale response to 100 percent step change; full isolation of I/O and continuous zero stability.

2. The flowmeter shall measure the flow rate (gpm, cfs, mgd) and output a 4-20 mA signal proportional to the flow rate to the PLC/SCADA panel. CONTRACTOR shall furnish and install the necessary cable, software, equipment and appurtenances to interface properly with the PLC/SCADA system. If the flow transmitter malfunctions for any reason or the flowtube becomes fouled, the flowmeter shall report an error to the PLC/SCADA system.

D. Flowmeter Cable:

1. CONTRACTOR shall furnish all cable and conduit between the flowtube and the flowmeter. The cable shall be of the type specified by the flowmeter manufacturer. Any connectors to the transducers that may be required shall be supplied by the flowmeter manufacture. The flowmeter cable shall be long enough to reach from the flowtube to the flow transmitter. The cable shall be continuous with no splices or connectors between the flow transmitter and the flowtube. All connections shall be rated NEMA 6 for submergence.

E. Installation:

1. The flowmeter manufacturer shall provide qualified field engineers to supervise the installation of the flowtube assemblies, placement and connection to the flow transmitter and commissioning of the flowmeter system. Also, refer to Section 40 6113 Process Instrumentation and Controls – General Requirements, for inspection, preparation, calibration, testing requirements, etc.
2. Transducer cable shall be routed through conduit from the flowtube to the flow transmitter.

F. Warranty:

1. The manufacturer shall furnish their standard one year from date of delivery warranty. The CONTRACTOR shall repair or replace any part that fails due to defects in materials or workmanship within 30 days of being notified. Any equipment which is replaced due to defects in material or workmanship shall carry a new two year manufacturer's warranty. All warranties shall be transferred to OWNER at project completion.

G. Calibration:

1. Prior to shipment of the flowmeter, the manufacturer shall do a factory calibration, input the data as appropriate, and compare the measured flow rate with the flow rate and level as calculated by the flowmeter. Flowmeter accuracy shall be within $\pm 0.5\%$. Any flowmeter that fails to calculate flow rate within the $\pm 0.5\%$ accuracy shall be repaired, replaced, or adjusted as approved by the ENGINEER to meet the accuracy requirement.

2.06 Turbidity Monitoring System

A. Description:

1. This section encompasses the selection and installation of a Turbidimeter and control system as a complete system for the continuous automated monitoring of low levels of particulate turbidity. The location of the Turbidity Monitoring System shall be as shown on the drawings.

B. Turbidimeter:

1. The Turbidimeter shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument meeting all design and performance criteria specified by USEPA method 180.1. Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells. Optical components shall be mounted in a sealed head assembly that can be removed easily for calibration/service, without disturbing sample flow. The Turbidimeter body shall be constructed of corrosion-resistant polystyrene, and shall include an internal bubble trap to vent entrained air from the sample stream. The Turbidimeter shall offer the choice of formazin-based (20 or 1 NTU) or instrument comparison-based calibration methods. Accuracy shall be $\pm 2\%$ of reading or ± 0.020 NTU (whichever is greater) from 0 to 40 NTU, and $\pm 5\%$ of reading from 41 to 100 NTU. Resolution shall be 0.001 NTU and repeatability shall be better than $\pm 1.0\%$ of reading or ± 0.002 NTU (whichever is greater). User selectable signal averaging, bubble rejection, alarm and recorder output hold, and self-test diagnostics shall be provided. All Turbidimeters on the network shall have RS232 serial input/output capability for two way communication to a computer or one way communication to a printer to record or print real-time turbidity data, calibration history and current set points.

C. Control System:

1. The control system shall be a microprocessor-based device capable of functioning as a single sensor, and/or as a digital interface link between multiple Turbidimeters and other communication devices through fieldbus communications, displaying data and operating multiple field instruments. The control system shall allow operators to control sensor and network functions with user-friendly, menu-driven software, and shall provide datalogging of measurement data from multiple Turbidimeters for 1 hour, 24 hours or 30 days, and the capability to transfer data to a computer or printer via an RS232 serial input/output device. The interface unit and separate DC power supply shall be housed in NEMA-4X (indoor) industrial plastic enclosures, and the power supply shall accept input of 120 VAC, 60 Hz.
2. A local indicator shall be provided adjacent to each Turbidimeter.
3. CONTRACTOR shall ensure that the selected Turbidimeter and control system is compatible.
4. The Turbidity Monitoring System shall be Hach Company Model 1720D or approved equal.

2.07 Particle Counting System

A. Description:

1. This section encompasses the selection and installation of a Particle Counter and associated microprocessor-based interface as a complete system for automated on-line particle counting of treated water. The location of the Particle Counting System shall be as shown on the drawings.

B. Particle Counter Sensor :

1. The particle counter sensor shall be an on-line, real-time continuous monitoring instrument utilizing light extinction technology for sizing and counting particles. The sensor light source must be a solid-state laser diode (780 nm infrared) capable of counting particles from 2 to 400 microns.

2. The system must be capable of sorting particles into a minimum of 5 user-adjustable channels. All sensors must be calibrated per ASTM 658. Calibration materials must be traceable to USA NIST.
3. Each sensor shall provide a minimum of four 4-20 mA output signals representing particle counts in adjustable size ranges, total counts, and flow or sensor status. The particle counter system must accept additional 4-20 mA input signals from other instruments.
4. The particle counter system must offer the option of an internal flow meter that will continuously monitor flow and notify the controlling system if the flow rate is below or above acceptable limits.
5. The sensor must track and indicate its need for periodic cleaning or maintenance automatically, either by communicating to the dedicated data acquisition system (computer) and/or by external alarm light. Each sensor shall have a LED indicator for power, sensor, sample cell and flow status (for sensors with an internal flow meter).
6. The particle counter sensor flow cell must be made of sapphire, which allows brush cleaning without damaging the wetted surfaces and minimizes mineral deposits on the optical surfaces. There shall be no quartz wetted surfaces which require frequent cleaning and/or replacement. Quartz wetted surfaces also have a tendency to stain or form deposits resulting in poor performance or failure. The sensor sample cell shall be no smaller than 1 x 1 mm in size. The sensor sample cell must be suitable for brush cleaning and accept a sample flow rate of 100 to 200 mL/min. A cleaning kit must be included with every sensor.
7. The particle counter must include a highly effective and reliable constant head device that reduces or eliminates bubbles and ensures a constant flow into the sensor. The constant head device shall function without the need for operator attention other than routine maintenance. The constant head device must accept a flow rate between 300 - 1000 mL/min. and come with a 40 mesh screen. The constant head device shall be partially made of transparent material for easy visual inspection and verification of flow.
8. All particle counter sensor components including power supply shall be housed in one module. All AC power shall be isolated from all wetted surfaces. The sensor, wetted surfaces and all electrical components shall be housed in a NEMA-4X enclosure with quick connect fittings.
9. The particle counting system shall communicate using RS485 serial communication. The particle counter must communicate directly to a dedicated data acquisition system (computer). The sensor must be designed so that a sensor may be disconnected, removed for calibration or service, without interrupting the data transmission from other sensors.

C. Software:

1. The software shall be a Windows-based personal computer software package used with the particle counter sensor in potable water applications. The software shall provide data displays that include real-time and historical plots, real-time and historical tabular displays, sensor status and system events. The sensor status display shall indicate customer alarm conditions. The tabular display shall include the sample point name, instrument status, most recent value, minimum, maximum, average and standard deviation for each channel of each sample point.

2. Three-dimensional bar graph histogram capability also shall be included to allow display of particle counts overall size channels for a single sensor, particle counts from several sensors and the relationship among dissimilar data items.
3. Calculated Sample Points (CSP) shall be permitted to report log removal and percent efficiency. Statistical operations such as average, minimum, maximum, standard deviation and total shall be included.
4. There shall be four programmable alarm levels for each sensor. Each state of alarm shall be displayed by changing the displayed result background and type colors. System event and event warning conditions also shall be displayed by changing the display background and type color.
5. The sample alarm and event warning notification priority shall be selectable by the user.
6. Simultaneous multiple data viewing capability shall be permitted. For example, graphics tabular spreadsheet and histogram data presentation shall be displayed simultaneously when needed. Automatic cascade and tile screen presentations shall be selectable in a manner equivalent to Microsoft Windows operating system. Display size and positioning shall be controlled and sized by clicking and dragging with the mouse.
7. The software shall include internetworking to permit multiple systems to provide remote analysis of system data. TCP/IP communications interface for connection to third party SCADA type packages shall be provided.

D. Hardware:

1. CONTRACTOR shall provide a suitable Windows-based personal computer (PC) to operate the software package used with the particle counter sensor. The PC shall be a have a Pentium III microprocessor, Windows™ 98 or later, 2 GB hard disk drive, 1.44 MB 3-1/2 inch disk drive, one RS232 or RS485 serial communication port, one BB485CON/PS RS232/RS485 converter for each RS232 port used (included with software), 64 MB RAM, parallel printer port, Windows compatible printer, VGA compatible display, PS/2 mouse port.
2. CONTRACTOR shall ensure that the selected particle counter, software, and hardware are compatible and operate as a complete system.
3. The Particle Counting System shall be Hach Company Series 1900 WPC, Cemtrac Model PC 2400 D, or approved equal.

2.08 Chlorine Analyzer

A. Description:

1. This section encompasses the selection and installation of an on-line chlorine analyzer for the continuous automated monitoring of residual chlorine concentration of treated water prior to entering the distribution system. The location of the chlorine analyzer shall be as shown on the drawings.

B. Chlorine Analyzer:

1. The chlorine analyzer shall be a continuous-reading, on-line colorimetric instrument utilizing DPD (N,N-Diethyl-p-phenylenediamine) chemistry to determine total residual chlorine. The analyzer must detect chlorine in the 0 to

5 mg/L range with 0.01 resolution and have an accuracy better than $\pm 5\%$ of reading or ± 0.05 mg/L, whichever is greater. The analyzer shall compensate for color and turbidity with an auto blank feature.

2. Analyzer shall have the ability to user select the output of 0-10 mV, 0-100 mV, 0-1 V or 4-20 mA in any portion of the 0-5 mg/L range. Two independent concentration set-point alarms can be programmed to actuate when chlorine residual goes above or below the set point concentration. The instrument must contain automatic, self-testing diagnostics to detect a possible malfunctions and actuate an operator alarm signal.
3. Analyzer shall have the capability to transfer data to a computer or printer via a RS232 serial input/output device.
4. CONTRACTOR will provide the chlorine analyzer with sufficient reagents for 120 days of operation.
5. Chlorine Analyzer shall be Hach Company Model CL17 or approved equal.

2.09 Radar Level Sensor

A. Equipment Description:

1. Microprocessor-based radar level gauge with analog output, superimposed with a digital HART® signal.
2. Frequency Modulated Continuous Wave (FMCW) radar signaling technology at 24 GHz frequency.
3. Measures the level of liquids, slurries, or sludges that may have a variety of severe process conditions.
4. Digital integral display and operator interface.
5. The unit shall have a Factory Mutual (FM) explosion proof approval.
6. Radar level sensor shall be APEX by Rosemount Inc. or ENGINEER approved equal.

B. Performance:

1. Gauge meets the following minimum performance criteria, which are stated at Reference Conditions:
2. Accuracy: ± 0.2 in. (5mm) for distances from 1.6 to 32.8 ft (0.5 to 10m) or $\pm 0.05\%$ of measured distance from 32.8 to 98.4 ft (10 to 30 m).
3. Measuring range: within accuracy specifications 1.6 to 98.4 ft (0.5 to 30 m) measured from the flange face.
4. Update Time: at least once every second.
5. Repeatability: ± 0.04 in. (1 mm).
6. Resolution: ± 0.02 in. (0.4mm).

C. Environmental Conditions:

1. Humidity: 5 to 100% relative humidity (with covers on).

2. Electronics/Housing temperature ranges:
 3. Standard: -40 to 158 °F (-40 to 70 °C)
 4. With Integral Display: -4 to 131 °F (-20 to 55 °C)
 5. Enclosure rating: NEMA 4X, CSA Type 4X, IP 66
- D. Electrical:
1. Gauge entry is ¾-14 NPT female conduit fittings.
 2. Gauge is factory sealed; conduit seal not required to meet FM explosion-proof requirements.
 3. Terminal block provides connections for ac or dc power and grounding.
- E. Power Supply: 24 V dc.
- F. Output: 4-20 mA analog signal (10.5 to 55.0 V dc powered), superimposed with a digital HART signal.
- G. Calibration:
1. Continuous frequency self-calibration ensures stated level accuracy.
- H. Software Functionality:
1. Gauge is capable of digital communication over the 4-20 mA output loop without disruption, using the HART Communications Protocol.
 2. All configuration data and programs are retained in non-volatile memory. Upon power interruption, all data is available when power is restored.
- I. Materials of Construction:
1. Electronics housing: aluminum alloy.
 2. Finish: polyester-epoxy paint.
 3. Antenna/flange assembly: Cone type, 4-inch, 316L stainless steel.
 4. Flange rating: 4-inch, ASME B16.5 (ANSI) Class 150
 5. Waveguide process barrier: alumina, PTFE.

2.10 Acceptable Manufacturers

- A. Acceptable manufacturers of certain equipment and components, not previously indicated are given below:
1. Liquid Level Switch: Consolidated Electric, Anchor Scientific "Rotofloat"; or equal.
 2. Float Switch Systems - Intrinsically Safe Relay: B/W, Warrick; or equal.

Part 3 Execution

3.01 Installation

- A. Installation of all equipment, materials, and components shall be by the Contractor under the direct supervision of the manufacturer and as indicated on the Contract Drawings.

3.02 Field Quality Control

- A. Testing on equipment, materials, and components herein specified shall be as specified in Section 40 6113 Process Instrumentation and Controls – General Requirements, Section 26 0500, Electrical General Requirements and Section 26 0510, Basic Materials and Methods.

3.03 Adjustments

- A. CONTRACTOR shall make all adjustments necessary to place all equipment, materials and components of the instrumentation and control systems in proper operating condition under normal operating and load conditions.
- B. The services of a factory trained, qualified service representative of the Equipment Manufacturer shall be provided to inspect the complete equipment installation to ensure that it is installed in accordance with the Specifications and manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation, and instruct the operating personnel in the proper care and operation of the equipment furnished.

3.04 Calibration Test Equipment/Spare Parts

- A. In order to maintain and calibrate the equipment, CONTRACTOR shall provide the following calibration and test equipment. This Specification covers the following equipment:
1. Instrument Calibrator:
 - a. Function: Portable instrument to monitor and calibrate level control instrumentation. Measures volts, mA, RTD's, thermocouples, frequency, and ohms to test sensors and transmitters. Source/simulate volts, mA, thermocouples, RTD's, frequency, ohms and pressure to calibrate transmitters.
 - b. Indication: LCD readout
 - c. Manufacturer: Fluke 789 Multifunction Process Calibrator or equal.

Function Measure or Source	Range	Resolution	Accuracy
Voltage	0 to 100mV	0.01 mV	
	0 to 10 V (source)	0.001 V	.02% Rdg. +2 LSD
	0 to 30 V (measure)	0.001 V	
mA	0 to 24	0.001 mA	.02% Rdg. +2 LSD
mV	-10.00 mV to +75.00mV	.025 % of range +1 LSD	
Resistance	0 Ω to 3200 Ω (measure)		
	15 Ω to 3200 Ω (source)		0.01 Ω to 1.0 Ω
Frequency (source)	2.0 to 1000.0 CPM	0.1 CPM	$\pm$.05% of setting
	1 to 1000 Hz	1Hz	$\pm$.05% of setting
	1.0 to 10.0 kHz	0.1 kHz	$\pm$.25% of setting
Frequency (measure)	1 CPM to 10 kHz	5 digits	0.05% Rdg +1 count
Loop Supply	24 V dc		10%

2. Spare Parts and Consumables:
 - a. To minimize "down time," the following spare parts and consumables shall be turned over to the OWNER at time of start-up:
3. Strip Charts
 - a. 24 charts shall be provided for each strip chart recorder furnished under this Contract. Any charts consumed during the construction or start-up phases of this Contract shall be replaced.
4. Spare Parts
 - a. CONTRACTOR shall furnish as manufacturer's spare parts, 6 pilot light lamps, one spare relay of each type furnished, one spare push buttons of each type and head color furnished and one spare selector switches of each type furnished.

3.05 Guarantee

- A. The float switches shall have 3-year factory warranties.

End of Section

Division 41
Material Processing and Handling Equipment

Section 41 22 23 Hoist and Monorail

Part 1 General

1.01 Summary of Work

- A. Scope of work includes labor, materials, and equipment necessary for furnishing the fabrication, production, installation, or erection of the items specified in this Section as shown on Drawings or listed on Schedule. The Work shall include hoist rail, hoist switches, trolley, hoist, appurtenances and controls.
- B. A named equipment manufacturer is still responsible for providing the equipment in accordance with the project specifications.
- C. Monorail and hoist are designed to lift the centrifuge motor or the centrifuge rotating assembly, but it is NOT designed to lift them simultaneously.

1.02 Quality Assurance

- A. This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of the section and those of the listed documents, the requirements of this section shall prevail.
 - 1. OSHA Part 1926.554-Overhead Hoists
 - 2. OSHA Part 1910.179-Overhead and Gantry Cranes
 - 3. ANSI/ASME HST 1999-Performance Standard for Overhead Electric Wire Rope Hoists
 - 4. ANSI/ASME B30.16 – Overhead Hoists
 - 5. ANSI/ASME B30.2 – Overhead and Gantry Cranes
 - 6. ASTM A36, Steel
 - 7. ASTM A 242, Steel
 - 8. ASTM A 588, Steel
 - 9. SAE 4140, HiCarbon Flats

1.03 Submittals

- A. Shop Drawings and Product Data:
 - 1. Submit in accordance with Section 01 3300, Submittal Procedures, covering the items and warranties included under this Section.
 - 2. Complete catalog information, make; model, weight; horsepower, and power requirements, descriptive literature, materials of construction, and specifications on hoist, wheels, gears and bearing, trolley drive system, hoist motor and assemblies, hook, brakes, starting system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, spreader bar, and accessories.

3. Shop drawings will detail the connection of the monorail to the superstructure. It will be the responsibility of the hoist manufacturer to coordinate with the Contractor to include any additional support beams necessary to adequately support the monorail system.
 4. Shop drawings shall include details for the following: all connection points between the monorail and the superstructure; brackets; hangers; the proposed monorail switches; hoist and trolley; electrical connections; festooning; hoist attachments; and other details as necessary to fully describe the complete working monorail, hoist and spreader beam system. It will be the responsibility of the hoist manufacturer to coordinate with the Contractor to include any additional support beams necessary to adequately support the monorail system.
 5. Drawings shall be signed and sealed by a licensed professional engineer.
 6. Power and control wiring diagrams, including terminals and numbers.
 7. Motor nameplate data in accordance with NEMA MG1 and including any motor modifications
 8. Factory finish system
 9. Storage and handling instructions
- B. Operation and Maintenance Data:
1. Submit in accordance with requirements of Section 01 3300 Operation and Maintenance manuals for items included under this Section.

1.04 Delivery, Storage and Handling

- A. Deliver, store, protect, and handle products to site in accordance with manufacturer's storage recommendations.
- B. Finished parts of hoists and trolleys shall be properly protected and be slushed with compound before shipment.
- C. Disassembled parts shall be match marked to facilitate assembly in the field

1.05 Quality Assurance

- A. Regulatory Requirements:
 1. Comply with provisions of the following:
 - a. OSHA: All equipment furnished shall meet all the requirements of the Federal Occupational Safety and Health Act.
 - b. Michigan Department of Labor, Occupational Safety Standards for General Industry (MIOSHA).
- B. Permits, Tests, and Inspections:
 1. Obtain required municipal and State permits. Arrange for inspections and make tests required thereby.

Part 2 Products

2.01 Manufacturers

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
 - 1. ACCO/Louden,
 - 2. EMH Cranes
 - 3. Gaffey Cranes/Ace Industries
 - 4. Yale Hoists
 - 5. Columbus McKinnon
 - 6. Coffing Hoists
 - 7. Tandomloc Inc.

2.02 Materials and Components

- A. Monorail, hoist, wire rope, and spreader beam shall have 3 TON capacity.
- B. Monorail:
 - 1. Monorail track capacities shall be determined so that deflection shall not exceed $L/600$ in the vertical and $L/400$ in the horizontal where "L" is equal to the span.
 - 2. Rails shall be joined with web type and other suitable coupling to provide flush, level connections. The gap permitted between adjacent ends of load carrying flanges shall be 1/16 inch
 - 3. Suitable safety stops shall be provided at all open and tracks and operating stop points such as walls and equipment. They shall be capable of withstanding the impact of the loaded carrier
 - 4. Rail sections shall be mounted to the support beams.
- C. Electric Motor Driven Trolleys:
 - 1. Hoist and trolley shall be of the same manufacturer.
 - 2. Trolley shall operate from the same push-button as the hoist.
 - 3. Trolley shall be powered from a festooned system from the RAK.
 - 4. Trolley shall be infinitely variable speed, VFD driven.
 - 5. Trolley stops shall be provided to allow maximum travel of the trolley hoist while also preventing contact between the hoist and building structure or equipment.
 - 6. Suitable safety stops shall be provided at all open and tracks and operating stop points such as walls and equipment. They shall be capable of withstanding the impact of the loaded carrier.
- D. Electric Motor Driven Hoist:
 - 1. Hoist and trolley shall be of the same manufacturer.
 - 2. Hoist shall be close head room, cross mounted type.
 - 3. Hoist shall be wire rope.

4. Hoist shall be two-part reeved with alloy steel forged hook.
 5. Lowering shall be only by means of continuous application of power to the hoist motor.
 6. Provide four rotary cam limit switches, or switch system with four micro-switches, to provide automatic upper and lower limit of hoist travel, hoist slow down at upper limit and phase sequence at upper limit
 7. Hoist motor brake shall be DC disc type with adequate torque to stop and hold 125% of rated load.
 8. Hoist shall be equipped with an electro-mechanical load limiting device that shall prevent lifting more than 110% of rated load.
 9. Hoist motor shall be two-speed
- E. Trolley and Hoist Controls:
1. Controls shall be assembled in a NEMA 4X enclosure.
 2. Controls shall provide variable speed.
 3. Control panel shall include a main disconnect.
 4. Control push button station shall be an independently festooned pendant with controls for all directions and shall include emergency stop and ability to open main disconnect.
 5. Controls shall include motor overload protection for each motor.
- F. Spreader Beam:
1. Hoist connection shall be off-center; 97 inches from one end's pick point and 89 inches from the other end's pick point.
 2. Hoist shall have pick points located at the ends of the beam, under the hoist connection; and at 73 inches (toward the 97 inch pick point).
 3. Hoist shall have a removable counterweight of 1,036 lbs that can travel the full length of the beam limited only by the ends of the beam or the pick points that are in use.
 4. Counterweight shall move freely and smoothly between the pick points with minimal effort using a chain-wheel or motorized controls with fine adjustment.
 5. Beam shall be marked with the desired location of the counterweight to create a level beam when unloaded.
- G. Conductor Electrification System:
1. The conductor electrification system shall be the festoon type with all necessary hardware for layout and installation. Conductors shall be of ample size and material for the service required and the systems shall include all necessary supports, clamps, insulators, expansion joints and other appurtenances. The use of runway rails as one of the conductors will not be permitted. The electrification system shall include a NEMA 4X termination enclosure for service and power distribution. Connections to the conductor systems shall be specified and

provided under Division 26, ELECTRICAL. Installation shall be in accordance with manufacturer's recommendations and guidelines.

2. The conductor electrification system shall be a festoon style manufactured by Duct-O-Wire Company, Hubbell-Gleason, or equal.

2.03 Hoist Rail and Appurtenances

- A. Hoist rail layout based on issued for construction drawings.
 1. Monorail beam dimensions shall be as necessary to accommodate the anticipated hoist and trolley and the proposed layout.
 2. Monorail beam switches shall be provided by the same manufacturer as the monorail to provide a complete coordinated design.
 3. Monorail switches shall be manual.
 4. Monorail manufacturer to provide all stops.
- B. Hoisting Straps:
 1. 2 pairs of hoisting straps (4-foot and 8-foot) shall be provided.
 2. Hoisting straps shall be of the same capacity as the hoist.

Part 3 Execution

3.01 Inspection

- A. Prior to commencing crane hoist installation, inspect hoist ways and building superstructure as constructed.
 1. Verify all critical dimensions and examine supporting structure and all other conditions under which hoist work is to be installed. Notify ENGINEER in writing of any dimensional discrepancies or other conditions detrimental to the proper installation or performance of hoist work.
 2. Do not proceed with hoist installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 Installation of Crane Hoist

- A. Comply with manufacturer's instructions and recommendations for Work required during installation.
- B. Provide welded connections for installation of hoist work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Advise CONTRACTOR, OWNER, ENGINEER, and inspection department of governing agencies in advance of dates and times tests are to be performed on hoists.

3.03 Field Quality Control

- A. Acceptance Testing: Upon nominal completion of each hoist installation, and before permitting use of hoist, perform acceptance test as required and recommend by Code, and by governing regulations or agencies.

- B. Operating Tests: Load each hoist to its rated capacity and operate continuously over its full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of pump motor during test period. Record failures of hoist to perform as required.
- C. Advise CONTRACTOR, OWNER, ENGINEER, and inspection department of governing agencies in advance of dates and times tests are to be performed on hoists.

3.04 Hoist Schedule

Quantity:	One
Rated Load Capacity:	3-ton capacity with impact load
Hoist Type:	Electric 3-ton chain hoist
Trolley Type:	Electric
Trolley Capacity	3-ton
Rated Speed:	
Hoist/Lift:	two speed, 31/5.2 FPM
Trolley:	two speed, 80/20 FPM
Maximum Vertical Lift:	35 feet
Power Supply:	460-3-60
Motors and Controls:	NEMA 4X; motor enclosure TEFC

End of Section

Section 41 1213.60

Dewatered Sludge Conveyance System

Part 1 General

1.01 Summary of Work

- A. This section specifies the requirements for the conveyance dewatered municipal wastewater sludge to roll-away bins or trailers. It includes the positive displacement progressing cavity pumps, complete with electric motors, and all specified appurtenances, as shown on the plans and specified herein. It also includes the knife gate valves complete with electric motors that determine into which portion of the bin/trailer the dewatered sludge is deposited, and the level sensors which identify when each portion of the bin/trailer is full. The dewatered sludge conveyance vendor shall include the control panels and control logic to provide a system that is integrated, and fully functional.
- B. The dewatered sludge conveyance system vendor shall provide operations and maintenance manuals, start-up assistance, and training and required herein.
- C. Furnish all labor, materials, tools, equipment, testing, and supervision required to complete successful installation and operation of the system, as indicated on the drawings and specified herein, and all other work incidental thereto, except as otherwise noted.

1.02 Related Work Specified Elsewhere

- A. Section 01 3300: Submittal Procedures
- B. Section 09 9000: Painting and Coating
- C. Section 11 0500: Common Work Results for Equipment
- D. Section 26 2923: Variable Frequency Motor Controllers
- E. Section 40 0552: Process Valves and Actuators

1.03 References

- A. This section contains references to the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of the section and those of the listed documents, the requirements of this section shall prevail.
- B. AGMA 6010-E-88 - Spur, Helical, Herringbone, and Bevel Enclosed Drive
- C. AGMA 6019-E-89 - Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
- D. AGMA 6023-A88 - Design Manual for Enclosed Epicyclic Gear Drives

1.04 Performance and Design Requirements

- A. Progressive Cavity Pumps:
 - 1. Dewatered sludge handling pumps shall be specifically designed and selected for continuous duty pumping of liquids with percent solids up to 32%
 - 2. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load

3. The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates
4. Manufacturers not named in this specification must provide a pre-submittal package to ENGINEER for approval. The pre-submittal package must include, at minimum, the following: dimensional drawing; performance curve; O&M manual; electrical/drive details; installation list (for the same liquids as specified) with minimum three contacts and phone numbers. Submittal of equipment that is either not named or approved will be rejected.
5. Operating Conditions:

Equipment Service	Rated Capacity (gpm)	Differential Pressure (psi)	Max/Min Pump Speed (rpm)	Discharge Port Size (inches)	Min Pump Drive (hp)	Drive Type
High Flow	55	100	57	6	25	Variable Speed
Low Flow	15	100	15			

- B. Knife Gate Valves
 1. As specified in Section 40 0552, Process Valves and Actuators
- C. Actuators
 1. As specified in Section 40 0552, Process Valves and Actuators
- D. Laser Level Sensors
 1. As specified in 40 6300, Instrumentation and Controls

1.05 Submittals

- A. Shop drawings are required for each item in this section of the specifications, including, but not limited to progressive cavity pumps, valves, actuators, sensors, couplings, gaskets, fittings, layouts, dimensions, etc. in accordance with Section 01 3300, Submittal Procedures.
- B. Submittals for equipment shall include the following types of information: warranty; performance curves; capacity; head; weights; motor data; horsepower; O&M manuals; and identification of where the product does not meet specification (if any).
- C. Test plans and reports

1.06 Delivery, Storage, And Protection

- A. Properly store, protect, and handle all pipe per manufacturer recommendations.

Part 2 Products

2.01 Progressive Cavity Pumps

- A. Manufacturer: SEEPEX Series BTHE or ENGINEER approved equal
- B. Material:
 1. Rotor CA45 Steel – Duktıl Coated
 2. Stator Buna N

- 3. Pump Body
- 4. Shaft Sealing

Cast Iron / Steel
Grease Lubricated Packing

- A. Rotor and Stator: Each pump shall be a minimum two (four, eight) stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid. Gaskets or "O" rings may not be used to form this seal. Stators for sludge pumps shall have Buna elastomer. The sludge pump rotors shall be constructed of 316 SS. Additionally the sludge pump rotors shall have a chromium nitride coating (Duktil) with a minimum thickness of 250 μm (.0108"). Hard chrome plating or ceramic coatings are not acceptable due to the ease at which this coating will crack and the lack of diffusion into the rotor base metal.
- B. Rotor and Drive Train: The rotor drive train shall be warranted for one (1) year from acceptance and shall consist of the following: ach pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450°F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel. A stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass. The universal joints shall carry a separate warranty of 10,000 operating hours. This warranty shall be unconditional in regards to damage or wear.
- C. Casing: A 150 pound (ANSI B16.5) flanged connection shall be provided at the discharge port. The discharge casings shall each be provided with a 3/8-inch (or larger) tap to permit installation of pressure instruments. The suction casing shall be fabricated from corrosion resistant steel plate. A single helix ribbon auger shall run the entire length of the suction casing and the extension tube. The ribbon auger shall turn concentrically in the hopper. The auger shall be driven by the main pump drive gearmotor. The ribbon auger and extension tube work in concert to apply additional shearing forces against the thixotropic sludge to reduce the apparent viscosity of the material, minimize air entrainment and improve the volumetric efficiency of the pumping elements. The walls of the hopper shall be vertical to minimize bridging. Additionally, the auger speed shall be adjustable independent of the pump speed so that sludge bridging can be eliminated per the actual process requirements.
- D. Discharge Chute: Dewatered Sludge Conveyance System vendor shall be responsible for the discharge chute that transitions from the centrifuge diverter gate to the progressive cavity pump's hopper. Discharge chute shall have a port/hatch that will allow operators to easily capture a cake sample without allowing any leakage during operation.
- E. Shaft Seals and Bearings: Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gearmotor, designed for all loads imposed by the specified service. Shaft shall be sealed with minimum 5 rings of packing. Packing gland shall be grease lubricated.
- F. Motor and Drive Unit:

1. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II). Unless otherwise noted, motors shall be energy-efficient, TEFC motors
 2. Pumps require adjustable speed drives (VFDs). VFDs shall be constant torque type. The pump supplier shall be responsible for the provision of the fixed reduction between the motor and pump. The reduction ratio shall be that required to operate the pump at its maximum operating speed when the motor is operating at its nominal rated full speed. VFD-driven units may be operated at up to 90 Hz at the maximum speed
- G. Hopper: The hopper shall be manufactured from corrosion resistant steel plate and coated per Section 09 9000. The walls of the hopper shall be vertical to minimize bridging.
- H. Run Dry Protection: The stator shall be fitted with a sensor sleeve and thermistor sensor. A controller shall also be provided and shall be installed by CONTRACTOR in the motor control center. The controller shall monitor the stator temperature and activate a shutdown and alarm sequence if the stator temperature reaches the adjustable limit on the controller. The controller shall include a manual local and remote reset function. Input to the controller shall be 1x115VAC/60 Hz.
- I. Overpressure Protection: Each pump unit shall be supplied with a silicone-filled isolation ring with a dual mounted gauge and single point pressure switch. The pressure ranges for the switch and gauge shall be selected specifically for each specified service. The isolation ring shall be mounted between ANSI flanges, be sized according to the discharge pipe as shown on the plans, and be constructed with a carbon steel body and fittings with a Buna sleeve. The switch shall be SPDT, NEMA 4.
- J. Spare Parts and Standby Components
1. One set of special tools shall be provided to service the pumps. In addition, the following shall be provided for each pump size (as appropriate for type of drive provided):
 - a. One (1) stator assembly with TSE sensor sleeve
 - b. One (1) rotor
 - c. One (1) set universal joint assemblies
 - d. Two (2) set packing

Part 3 Execution

3.01 Factory Test

- A. Supplier to conduct in-factory functional testing of assembled unit.
- B. Supplier to submit protocol for factory test for ENGINEER's review.
- C. Simulate operation conditions and modes to confirm function.
- D. Simulate all alarm input conditions to verify appropriate alarm indication and shutdown functions.
- E. Supplier to submit factory test results report for review by OWNER prior to shipment of the assembled unit to the jobsite.

3.02 Delivery of Equipment

- A. Store and protect all equipment per Manufacturer's instructions.
- B. Replace any equipment damaged after receipt of equipment at CONTRACTOR's expense.

3.03 Installation

- A. Installation to be in strict accordance with the vendor's instruction and recommendations in the locations shown on the Drawings.
- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of CONTRACTOR to the above items shall be repaired or replaced by CONTRACTOR to its original condition.
- C. Interconnecting piping supplied by CONTRACTOR to be hydrostatically tested by CONTRACTOR.
- D. Verify all equipment installed per manufacturer's recommendations and literature and the Drawings.

3.04 Dewatered Sludge Conveyance System Representative's Services

- A. Provide installation instruction manuals for CONTRACTOR's assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Provide general assistance regarding handling, assembly and installation requirements for complete installation by CONTRACTOR
- C. Be present during placement and connection of the unit to power and liquid connections to instruct and observe installation.
- D. Inspect the installation prior to startup in order to verify that the equipment has been properly installed.
- E. Calibrate the equipment with OWNER's operator present after installation prior to startup
- F. Field testing and checking of installation to be approved by field representative
 - 1. Test under full load conditions
 - 2. Verify that all control system functions, including alarms, perform as specified
 - 3. Any spare parts furnished as specified but used during startup must be replaced prior to final acceptance
 - 4. Field representative to perform field test
 - 5. Provide certification
- G. Qualified factory-trained representative to provide startup and operator training services. Representative to be available within two (2) weeks of request for services. Representative to provide following services:

1. Equipment installation review and certification of proper installation: Provide one (1) trip; minimum of four (4) eight 8-hour days onsite for initial visit to checkout installation and verify that centrifuge system is ready to operate.
2. Startup and optimization: Provide a minimum for four (4) 8-hour days over one trip for optimization and performance testing of equipment.
3. Operator training: Provide one (1) trip of minimum two (2), 8-hour days to provide classroom training of operating personnel in the operation of centrifuge system and to provide "hands-on" training for operation of equipment
4. Six (6) month performance review and post startup training: One (1) trip of 8-hours minimum to make operating adjustments and provide additional instruction to OWNERS personnel within 6 months after final acceptance of equipment

End of Section

Division 43

Process Gas and Liquid Handling, Purification and Storage Equipment

Section 43 2321

Axial Horizontal Split Case Centrifugal Pump - Single Stage

Part 1 General

1.01 Description

- A. CONTRACTOR shall furnish materials, equipment and labor to furnish, install and test the pumping system complete with the pumps, motors, mounting bases, piping, valves and appurtenances, as indicated on the contract drawings and as herein specified.

1.02 Submittals

- A. In addition to submittals required in Section 01 3300 Submittal Requirements, submit the following data and drawings for review:
 - 1. Efficiency at full, 3/4, and 1/2 load
 - 2. Guaranteed minimum efficiencies at 100 percent, 75 percent, 50 percent, and 25 percent of full load
 - 3. Guaranteed minimum power factor at 100 percent, 75 percent, 50 percent, and 25 percent of full load

1.03 Installation

- A. CONTRACTOR shall ensure that the pumps and motors are properly installed with no pipe strain transmitted to the pump casing.

1.04 Responsibility

- A. To assure a properly integrated and compatible system, all equipment described in this section shall be furnished by the Pump Manufacturer, who shall assume full responsibility for the proper operation of the pumps and associated equipment.

1.05 Supervision

- A. CONTRACTOR shall arrange for the Pump Manufacturer to provide a factory-trained representative as required for the purpose of supervising installation, start-up, final field acceptance testing, and providing instruction to the owner's operating personnel in the proper operation and maintenance of the equipment in this section.

1.06 Reference Standards

- A. Work in this section is subject to the requirements of applicable portions of the following standards:
 - 1. Hydraulic Institute Standards
 - 2. IEEE Standards
 - 3. NEMA Standards
 - 4. OSHA Rules and Regulations

Part 2 Products

2.01 General Description

- A. The pump shall be a single-stage centrifugal vertical open shaft split case pump, Aurora Model 411-NSF 61 or Engineer Approved equal. Pumps shall be certified by UL to meet the NSF 61 standard for low lead.

2.02 Materials of Construction

A.	Casing	Cast Iron (ASTM A48)
B.	Impeller	Bronze (ASTM B62)
C.	Shaft	Carbon Steel (AISI C1045)
D.	Shaft Sleeve	Bronze (ASTM B62)
E.	Case Wearing Ring	Bronze (ASTM B62)

2.03 Casing

- A. The casing will be of the horizontal split case design. The casing shall have tapped and plugged holes for priming, vent and drain. Removal of the upper half of the casing must allow removal of the rotating element without disconnecting the suction or discharge piping. The lower half of the casing shall be furnished with cored passageways from the high pressure area of the volute to each seal box for positive lubrication without the use of external flushing lines. The bearing arms shall be cast integrally with the lower half of the casing to assure positive bearing alignment. In no case will bolt on bearing arms be acceptable. Each bearing arm will provide a reservoir area for accumulation of weepage from the stuffing box, and a drilled and tapped opening will be provided at the lower portion to allow piping by the Contractor to the nearest floor drain.

2.04 Impeller(S)

- A. The impeller(s) shall be designed to give the characteristics outlined under "Performance". They shall be of the enclosed type, cast in one piece. They shall be furnished all over, the exterior being turned, and the interior being furnished smooth and cleaned of all burrs, trimmings, and irregularities. The impeller(s) will be dynamically balanced. They shall be held securely to the shaft by a key of ample size and shall be locked in place by threaded shaft sleeves.

2.05 Shaft Sleeves

- A. The shaft sleeves shall be extended from the hub of the impeller, through the seal box area, and beyond the gland. They shall be sealed at the impeller hub by a Buna O-ring to prevent pumped liquid from contacting the shaft. They shall be threaded to hold them securely in place and designed so as to lock the impeller.

2.06 Case Wearing Ring

- A. The pump casing shall be fitted with case wear rings to minimize abrasive and corrosive wear to the casing. The wear rings shall be of the radial type, shall have a shoulder machined around the circumference to match a machined shoulder in the casing to provide two sealing faces and to locate the rings in the casing. The rings shall be securely located from rotation by means of pins to the lower casing half.

2.07 Stuffing Box

- A. A stuffing box shall be provided on each side of the pump casing, designed with sufficient area for incorporation of packing or mechanical seals.

2.08 Packing Glands

- A. Each stuffing box shall be furnished with a two-piece 316 stainless steel gland to securely hold the packing in place. The gland pieces shall be split to allow access to the packing without disassembly of the unit. Control of weepage shall be accomplished by the use of adjustable swing bolts.

2.09 Mechanical Seal Glands

- A. Each stuffing box shall be furnished with a one-piece 316 stainless steel gland to securely hold the mechanical seals in place.

2.10 Shaft

- A. Pump shaft shall be one-piece, finished and polished on all sections. The shaft shall be of ample strength and rigidity and the shortest practicable distance between bearings shall be used to keep deflection and vibration to a minimum. The maximum allowable deflection of the shaft is 0.002 inches at any point of operation on the pump curve.

2.11 Bearings

- A. Pump shall be supplied with a single row inboard bearing primarily for radial loads and a double row outboard bearing primarily for thrust loads. Both bearings shall be regreaseable lubrication ball type, designed for 250,000 hours average life. Each bearing shall be mounted in a machined housing that is moisture and dust proof. The housing shall have registered fits to assure alignment, pinned to prevent rotation, and bolted to the bearing arms. Each housing shall be supplied with a grease fitting and a plugged relief port.

2.12 Baseplate

- A. Pump and motor shall be mounted on a groutable steel baseplate or a steel drip rim baseplate with integral drip channels incorporated on each side. Each channel shall include an NPT connection and plug. The base shall be sufficiently rigid to support the pump and motor without the use of additional supports or members.

2.13 Motor

- A. Motor shall be vertical and in accordance with the latest NEMA standards, and shall have the following characteristics:

1.	Enclosure	TEFC 182T Frame
2.	Number of Phases	3
3.	Cycles	60 Hz.
4.	Voltages	460 Volt
5.	Speed	1200 RPM
6.	Horsepower	1.5 hp
- B. Each motor shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of at least 1.15. The service factor is reserved for variations in voltage and frequency.

2.14 Coupling

- A. A flexible coupling shall be provided to connect the pump shaft to the motor shaft. The coupling shall be of an all metal type with a flexible rubber insert. The entire rotating coupling element shall be self-aligning, double engagement, and enclosed by a coupling guard to be moisture and dust proof.

2.15 Packing

- A. Each stuffing box shall be fitted with rings of die-cut non-asbestos packing material constructed of interwoven graphite coated acrylic.

2.16 Mechanical Seal

- A. Optional mechanical seals shall be a John Crane Type 1 or Type 21 seal.

2.17 Data Plates

- A. Data plates shall be of stainless steel suitably attached to the pumps and shall contain:
 - 1. Manufacturer's Name
 - 2. Pump Size, Type, and Model
 - 3. Serial Number
 - 4. Maximum Speed
 - 5. Impeller Diameter
 - 6. Capacity
 - 7. Head Rating
 - 8. Other pertinent data identified by the manufacturer

2.18 Hardware

- A. All machined bolts, nuts, and capscrews shall be of the hex head type. Hardware requiring special tools or wrenches shall not be used.

2.19 Manufacturer and Model

- A. Pentair/Aurora 411 or Engineer approved equal

Part 3 Execution

3.01 Conditions of Service

- A. The following conditions of service shall be strictly adhered to:
 - 1. Number of Units 2
 - 2. Type of Drive Direct coupled
 - 3. Discharge Size, minimum 2 in.
 - 4. Suction Size, Minimum 2.5 in.
 - 5. Design Capacity 60 GPM
 - 6. Design Head 31 feet TDH.
 - 7. Efficiency at Design minimum 57 %
 - 8. Rotative speed, maximum 1200 RPM
 - 9. Shut-off Head 34 ft.
 - 10. Drive Horsepower 1.5 hp
 - 11. NPSHR at Design, maximum Ample Available

3.02 Inspection and Factory Tests

- A. Each centrifugal pump furnished under these specifications shall be tested at the factory to verify individual performance. Certified copies of all test reports shall be submitted to the Engineer for approval prior to shipment. Each unit shall be hydrostatically tested in accordance with the Hydraulic Institute Standards.

3.03 Installation and Acceptance Tests

- A. Pumping units shall be installed in accordance with the instructions of the manufacturer and as shown on the drawings by the Contractor.
- B. Installation shall include furnishing the required oil and grease for initial operation. Grades of oil and grease shall be in accordance with the manufacturer's recommendations.

3.04 Spare Parts

- A. CONTRACTOR shall furnish the following spare parts:
 - 1. One (1) impeller of each size provided
 - 2. Two (2) sets of gaskets, o-rings, etc. for each pump
 - 3. Two (2) sets of each type of bearing
 - 4. One (1) impeller hub or shaft sleeve of each size provided
 - 5. One (1) of each type and size of coupling
 - 6. Two (2) complete sets of replacement packing
 - 7. One (1) of each type and size of wear rings
 - 8. One (1) stuffing box gland split with bronze bolts and nuts
 - 9. One (1) set of each size of motor bearings

End of Section

Division 46
Water and Wastewater Equipment

Section 46 3300

Liquid Chemical Feed Equipment

Part 1 General

1.01 Summary

- A. Section Includes:
 - 1. Polymer blending units and feed systems.
 - a. Mixing & Activation
 - b. Polymer metering pumps
 - c. Valves and piping appurtenances
 - d. Flow meters
 - 2. Bulk Liquid Polymer Storage Tank and Recirculation System
 - a. Recirc Pump and Controls
 - b. Level Monitoring System
 - c. Truck unloading Panel
 - 3. Integral system control panels
 - 4. Related Skid-mounted supports, frames, and floor stands
- B. Requirements:
 - 1. Polymer blending units and feed systems
 - a. Total capacity shall range from 1 to 6 gph
 - 2. Bulk Liquid Polymer Storage Tank and Recirculation System
 - a. 6000 gallons
 - b. Double-walled
 - c. HDPE

1.02 Reference Standards

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. National Electrical Manufacturers Association:
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 Submittals

- A. Section 01 3300, Submittal Procedures: Requirements for submittals.
- B. Product Data: System supplier shall submit data completely describing product and its performance characteristics, and shall include detailed scope of supply, detailed bill of materials and annotated specification sheets of all components.
- C. Shop Drawings:

1. Submit both shaded isometric, and orthogonal dimensional drawings and details.
 2. Indicate schedule of equipment components.
 3. Indicate materials of construction.
 4. Submit detailed wiring and control schematics and logic diagrams.
 5. Indicate installation and anchoring requirements, including operating weights, fasteners and other details.
 6. Indicate mounting details, and location and elevation of electrical controls and panels.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions regarding installation requirements, including storage and handling procedures, any special field procedures for layout and anchoring, installation, start-up and operating instructions.
- F. Source Quality-Control Submittals:
1. Prior to shipment the system shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connections whisker-free.
 2. The complete system shall be fully factory tested prior to shipment. Testing shall include setting and verification of all instrumentation and sensors per the design requirements of the application; pressure testing all plumbing systems for a minimum of one hour at 100 psi. If leaks are found they shall be fixed and a new test shall be conducted for one hour at 100 psi until the plumbing system is verified to be leak free; verification of system design flow rates, and; complete functional simulation of operation.
 3. Submit written report indicating results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of CONTRACTOR-furnished tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- I. Qualifications Statements:
1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.04 Closeout Submittals

- A. Section 01 7700, Closeout Procedures: Requirements for submittals.
- B. Project Record Documents: Record installed locations and final orientation of equipment and accessories.

1.05 Qualifications

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.06 Delivery, Storage and Handling

- A. Section 01 6000, Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 - 1. Additionally, the polymer blending equipment shall be shipped in a new, high quality completely enclosed weatherproof wooden crate constructed of 2" x 4" studs and 3/8" thick plywood. Access to the crate shall be by a front panel removable by lag bolts. A skid shall be constructed of 4" x 4" or two 2" x 4" each, allowing fork-lifting. The crate shall include a shock sensor to warn of equipment mishandling during shipment.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.07 Existing Conditions

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.08 Warranty

- A. Section 01 7700, Closeout Procedures: Requirements for warranties.
- B. The polymer blending and feed equipment shall be covered by a five (5) year limited warranty against defects in materials and workmanship. The mixing chamber shall be warranted for the life of the system against failure for plugging for any reason. The warranty shall exclude failure due to over pressure or freezing

Part 2 Products

2.01 Manufacturers

- A. VeloDyne - Velocity Dynamics of Louisville, CO
 - 1. Dewatering Polymer System, VM-15P-6000-E
- B. ENGINEER's preapproved equal. These specifications are based on a multi-stage, multi-zone, hydro-mechanical polymer activation & blending technology as manufactured by VeloDyne. Any proposed alternate must be proven to provide at least an equal level of performance, reliability, versatility and quality to the system specified prior to the bid.

If, after installation, it is shown that the alternate system does not provide an equal level of performance, reliability, versatility and quality to that specified, CONTRACTOR shall replace the system with the specified system at their sole cost.

2.02 System Description

A. The system supplier shall provide:

1. Two (2) polymer blending units (PBU) capable of automatic metering, dilution, mixing, activation, and feeding of liquid polymer.
 - a. The polymer activation system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1% to 1% concentration of emulsion polymers with active contents up to 75%.
 - b. The polymer activation system shall include progressive cavity pumps, motors and controls, including all integral piping, valves, fitting, pipe supports, special equipment and appurtenances in accordance with these specifications, including all incidental work necessary to make it complete, satisfactory and ready for operation system. Interconnecting piping and electrical between equipment shall be field installed by CONTRACTOR.
2. Two (2) water filters to strain the service water to the desired purity at the desired flow rate.
3. One (1) bulk polymer storage system to unload, store, monitor inventory and include recirculation to avoid polymer stratification
 - a. Enclosed and covered
 - b. Filled from the top with an internal drop fill line that terminates 1- 2 feet from the invert of the tank
 - c. Emptied from the bottom with a minimum 4-inch diameter flanged connection
 - d. Recirculation inlet and outlet ports
 - e. Double walled polyethylene with minimum secondary containment of volume of 115%
 - f. Minimum 3-year manufacturer's warranty
 - g. Integral volume measurement markings
 - h. Draw and fill assemblies as shown on the drawings
 - i. OSHA Ladder
 - j. Minimum 18" manway access cover
 - k. Leak detection sensor
 - l. U-vent
 - m. Ultrasonic level measurement in accordance with Section 40 6300.

2.03 System Components

A. Polymer Blending Systems:

1. System Design Parameters:
 - a. Polymer Type: Emulsion
 - b. Polymer Activity (% active): 30-75%
 - c. Solution Concentration Range: 0.1% to 2% based on neat polymer
 - d. Solution Concentration Design Point: 0.5% based on neat polymer
 - e. Pump Type: Progressive cavity
 - f. Drive: Direct
 - g. Polymer Flow Rate:
 - (1) Centrifuge Dewatering Polymer Skids: 0.75 to 15 gph
 - h. Dilution Water Flow Rate:
 - (1) Centrifuge Dewatering Polymer Skids: 600 to 6000 gph at 35-50 psig above pressure at point of use
2. Polymer Activation and Blending Chamber shall employ multi-stage hydro-mechanical polymer blending technology with both a non-mechanical and a mechanical mixing stage in order to provide reliable control, and versatile operations over a wide range of available polymers.
 - a. Non-mechanical stage shall be capable of activating polymer based on dilution water pressure alone at 30 psid or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is in no way diminished prior to contact between water and polymer. The non-mechanical zone shall be designed such that the velocity of the mixing energy producing water jet is maintained or increases as flowrate decreases.
 - (1) The non-mechanical stage shall contain a neat polymer injection check valve assembly specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

- b. Hydro-mechanical mixing stage shall be capable of producing mixing energy independent of the dilution water pressure. This stage shall utilize a specially designed chamber containing a stainless-steel hydro-mechanical impeller which shall impart both axial and radial flow to optimize mixing effectiveness and provide ultra-high, non-damaging activation energy. The impeller speed shall be variable to optimize polymer activation energy throughout its entire operating flow range.
 - (1) The mixing chamber shall at all times maintain velocity in the entire chamber high enough to prevent polymer build up within the chamber.
 - (2) The mixing chamber shall have a maximum rated pressure of 100 psi and contain an integral pressure relief factory set at 75 psi.
 - (3) The mixing impeller shall be controlled by an SCR motor and driven by a wash down duty motor. The motor shall be mounted horizontally or above the mixing chamber, never under it.
 - (4) The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. All bearings shall be external from the mixing chamber.

3. Dilution Water Assembly:

- a. Dilution water flow rate shall be measured utilizing a paddlewheel flow meter capable of accurately measuring flow throughout the range specified above. Flow sensor mounting shall be via insertion to permit easy removal for periodic cleaning.
- b. Unit shall have an electric solenoid valve for on/off control of dilution water supply flow.
- c. Unit shall have a linear actuated variable rate control valve to automatically proportion water flow to polymer flow for polymer / water ratio control. Valves that diminish mixing energy in the non-mechanical stage shall not be used.
- d. A differential pressure switch shall be provided to serve as a pressure alarm. The switch shall be adjustable between 9 and 60 psid. Static working pressure, 500 psi. The pressure switch shall be as manufactured by Ashcroft or WIKA.
- e. Dilution water assembly shall be furnished with a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure. Gauge shall be manufactured by Ashcroft or WIKA.

4. Neat Polymer Metering Pump:

- a. Unit shall have one (1) neat polymer metering pump integrally mounted on the systems skid. The metering pump shall have a range as specified above. Pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be a lip seal

type riding on a ceramic sleeve. Mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel. Motor speed shall be controllable by external analog 4-20 mA signal input to system control panel.

- b. Pump suction piping on the skid shall be furnished with a connection piped to a calibration column with two full port PVC ball valves having Viton o-rings. Column shall be calibrated for a one-minute draw-down at maximum pump rate and read in GPH and milliliters. Calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets.
 - c. Provide a pressure gauge / switch assembly with stainless steel diaphragm isolator to monitor polymer line pressure.
 - d. Provide a non-intrusive thermal type loss of polymer flow sensor
5. Solution Discharge Assembly:
- a. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor system discharge pressure.
6. Control Panel:
- a. A control panel shall be furnished integrally mounted on the Polymer Blending Skid. The enclosure shall be rated NEMA 4X and constructed of FRP. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire raceway and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements.
 - b. Power: 120 VAC, 1PH, 60 HZ with a main power rotary style disconnect switch. Circuit breakers shall be provided on each motor circuit and the main control circuit. Fuses shall not be used for circuit protection.
 - c. For the Centrifuge Dewatering Polymer System, the control panel shall consist of:
 - (1) Operator Interface:
 - (a) Discrete Selector Switch: System ON / OFF (reset) / REMOTE
 - (b) One-turn potentiometer: Mixer Speed
 - (c) Ten-turn potentiometer: Progressive Cavity Pump Speed Control

- (2) Status / Alarm Indicators:
 - (a) Main Power ON
 - (b) Display of Polymer Feed Rate
 - (c) Low Water Differential Pressure Alarm
 - (d) Low Polymer Flow Alarm
- (3) Inputs:
 - (a) Remote RUN/STOP (discrete dry contact)
 - (b) Polymer pacing signal based on process flow (analog 4-20 mA)
- (4) Outputs:
 - (a) System Running (discrete dry contact)
 - (b) Remote Mode (discrete dry contact)
 - (c) Common Alarm (discrete dry contact)
 - (d) Polymer pumping rate (analog 4-20mA)

B. Bulk Liquid Polymer Storage System

- 1. One (1), double wall containment, closed dome top, flat bottom vertical tank.
- 2. Recirculation Pump: Provide one (1) liquid emulsion polymer recirculation pump on a single 304 stainless steel skid constructed of 316 stainless steel 2" x 2" x 1/8" structural tubing frame and sheet metal (minimum 10 GA) mounts and drip pan under the pump fitted with 1" NPT threaded drain connection. Skid shall include full-port inlet and outlet isolation valves and a control panel as specified below.
 - a. The recirculation pump shall be a progressive cavity type constructed of stainless steel and Viton with packing shaft seal. Due to the potential of premature seal failure due to polymer adhesion of the seal surfaces, mechanical shaft seals shall not be acceptable. Pump shall be capable of recirculating liquid emulsion polymer having a dynamic viscosity of 250 cps at a rate of 50 gpm (one tank volume turn over per two hour period) and at a speed not to exceed 210 RPM. The pump motor shall be 3 HP 480VAC, 3PH, 60 Hz TEFC.
 - b. The control panel shall be integral to the recirculation pump skid. The control panel shall consist of all power transformers, digital displays, panel mounted timers, potentiometers, switches, lights, relays, motor starters and other control devices required for a complete operable system. Power shall be 480 VAC, 3PH, 60 Hz. Provide a main power disconnect. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire raceway and numbered with heat-shrink type labels. Adhesive labels shall not be used. The control panel shall be rated NEMA 4X and positioned such that there are no obstructions in front of the control panel per related NFPA requirements. The control panel shall include the following control features:

- (1) HAND/OFF/AUTO switch
- (2) START/STOP pushbuttons
- (3) ON and OFF delay timers – programmable in hours and minutes of time.
- (4) Program to run 2 hours every other day
- (5) Indicator: Main Power ON
- (6) Indicator: Motor Overload ALARM
- (7) Indicator: Pump Run-Dry ALARM
- (8) Input: None
- (9) Output: Pump RUNNING
- (10) Output: In AUTO
- (11) Output: Common ALARM

C. Materials: Unless specified in the component description the following material requirements will be strictly adhered to:

- 1. Frame and Skid: Type 304 stainless steel.
- 2. Hardware: Type 18-8 stainless steel
- 3. Inlet / Outlet Fittings: 304 stainless steel
- 4. Piping and pipe fittings: PVC Schd 80
- 5. Tubing & tube fittings: polyethylene, polypropylene, stainless steel and viton
- 6. Water Solenoid Valve: brass
- 7. Supports: Steel members
- 8. Pressure gauges: stainless steel, liquid filled
- 9. Pressure switches: NEMA 4, brass connection
- 10. Flow meter: PVC and or polypropylene
- 11. Water control valve: stainless steel with stainless steel seat
- 12. Mixing chamber body / flanges: stainless steel
- 13. Mixing chamber cover / chamber: clear polycarbonate
- 14. Mixing Chamber Discharge: stainless steel
- 15. Impeller: 304 stainless steel
- 16. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
- 17. Mixing chamber pressure relief valve: brass, stainless steel or PVC
- 18. Metering pump wetted parts: stainless steel & Viton
- 19. Metering Pump Shaft Seals: Viton, stainless steel ceramic, carbon
- 20. Control enclosure: FRP

D. Identification: Provide a name plate securely affixed to the unit providing Manufacturer with phone number, model number, and serial number

E. Finishes: According to manufacturer's recommended coating for service conditions

F. Accessories:

- 1. Pressure-relief valve.
- 2. Pressure Gages: As specified in Section 40 6300.
- 3. Static mixer.

4. Calibration column.
 5. Piping Supports: As specified in Section 40 0505.
- G. Spares & Special Tools:
1. For each activation chamber provide one (1) neat polymer check valve – complete.
 2. One (1) banding clamp tool for replacement of progressive cavity pump pin joint banding clamps
 3. For each size progressive cavity pump furnished provide:
 4. One (1) progressive cavity pump stator
 5. One (1) progressive cavity pump lip seal

Part 3 Execution

3.01 Examination

- A. Section 01 7700, Closeout Procedures: Requirements for installation examination.
- B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.02 Installation

- A. According to manufacturer instructions.
- B. Piping:
 1. Equipment Connections: Provide flexible connectors at equipment.
 2. Harness or anchor flexible connectors as necessary.
- C. Base Pads:
 1. Material: Concrete, as specified in Section 03 3000, Cast-in-Place Concrete.
 2. Minimum Size: As indicated on Drawings.
 3. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.

3.03 Field Quality Control

- A. Section 01 7700, Closeout Procedures: Requirements for testing, adjusting, and balancing.
- B. Field Testing:
 1. Test for proper alignment.
 2. Demonstrate operation without undue noise, vibration, or overheating.
 3. ENGINEER will witness field testing.
- C. Manufacturer Services: Furnish services of manufacturer's field service technician to inspect and certify the installation, commission and conduct system field testing, start-up the equipment, and providing complete and thorough training of OWNER's personnel. Field services shall consist of Three (3) eight (8) hour day, exclusive of travel time.

D. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.04 Demonstration

- A. Section 01 7700, Closeout Procedures: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to OWNER's personnel.

End of Section

Section 46 7436

Centrifuge Thickening Equipment

Part 1 General

1.01 Description of Work

- A. Furnish and test centrifuge complete with support frame with centrifuge stand, walkway, and ladder; control panel; and all other required accessories for satisfactory operation of centrifugal dewatering equipment and appurtenances as indicated and as specified.
- B. Centrifuge manufacturer will be responsible for providing a complete centrifuge system, as described herein, and for delivering the equipment to the project site. The polymer system is supplied separately, but shall be fully integrated as described herein.
- C. Equipment shall be installed by CONTRACTOR, who will be responsible for off-loading the equipment, providing any temporary storage in accordance with the manufacturer's recommendation for storage and installing the equipment in place. Installation will include mounting and piping the unit and providing power to the panels and all interconnected wiring and piping required between various components, if any.
- D. Drawings and specifications direct attention to certain features of the equipment, but do not purport to cover all details entering into the design and construction of the equipment, controls, or appurtenances.

1.02 Reference Standards

- A. ABMA – American Bearing Manufacturers Association
- B. ASME – American Society of Mechanical ENGINEERs
- C. ASTM – American Society for Testing and Materials
- D. ANSI – American National Standards Institute
- E. AWS – American Welding Society
- F. OSHA – Occupational Safety Health Administration
- G. IEEE – Institute of Electrical & Electronics ENGINEERs
- H. NEMA – National Electrical Manufacturer's Association

1.03 Definitions

- A. Centrifuge:
 - 1. Each centrifuge shall be a complete dewatering centrifuge system that includes the centrifuge bowl; scroll conveyor; main drive motor with variable frequency drive; hydraulic scroll drive system; bearings; seals; feed tube; solids and centrate discharge chutes; auxiliary equipment; control panels; control and monitoring instrumentation; diverter gate; six (6) foot stand with access platform; ladder; and other necessary appurtenances.
- B. Centrifuge Manufacturer:
 - 1. Centrifuge manufacturer and/or supplier.
- C. Percent Solids Capture Defined and Calculated as Follows:
 - 1. $\% \text{ Capture} = (T/F) \times ((F-C) / (T-C)) \times 100$

- D. T = dewatered sludge - total suspended solids concentration (mg/l)
- E. F = Feed sludge - total suspended solids concentration (mg/l)
- F. C = Centrate - total suspended solids concentration (mg/l)
- G. Bowl Diameter:
 - 1. Internal diameter of cylindrical section of centrifuge bowl.
- H. G-Volume defined and calculated as follows:
 - 1. $G\text{-Volume} = (\pi/4 (D_{\text{cyl}}^2 - D_{\text{isdd}}^2) \times L_{\text{cyl}}) \times (6.13 \times 10^{-8} \times N^2 \times D_{\text{cyl}})$, gal
- I. D_{cyl} – Maximum bowl diameter, inches
- J. D_{isdd} – Solids discharge diameter, inches
- K. L_{cyl} – Length of the cylinder, inches
- L. N – Bowl operating speed, rpm
- M. Definitions of G-Volume other than those specified and other methods of calculation will not be accepted. G-Volume shall be calculated with the centrifuge maximum recommended operating bowl speed.

1.04 System Description

- A. General:
 - 1. Specified centrifuges shall be of high speed, horizontal, cylindrical-conical, solid bowl, counter-current, scroll type designed for continuous operation.
 - 2. Centrifuges shall be capable of performing in accordance with the requirements set forth in these specifications. In order to be assured of meeting the required performance, the centrifuges shall be capable of operating at a max speed of 3150 rpm and a maximum operating G force of 3000 at the bowl wall. Speed control shall be provided by a solid-state variable frequency drive (frequency inverter).
- B. Components and Appurtenances:
 - 1. Equipment shall be furnished by the manufacturer of the sludge dewatering units; however, all equipment need not be manufactured by a single manufacturer.
 - 2. Components, including but not limited to the following, shall be considered as part of the sludge dewatering package and become the responsibility of the sludge dewatering equipment manufacturer:
 - a. Centrifuge Assembly
 - b. Main Drive Motor with Allan-Bradley Variable Frequency Drive
 - c. Hydraulic Scroll Drive System on 18" stand (for ease in changing oil)

- d. Lubrication System
- e. Control Panel and Wiring
- f. Motor Starters and Appurtenant Enclosures
- g. Flexible Connectors, Dewatered Sludge, and Centrate Chutes
- h. Spare Parts and Special Tools
- i. Centrifuge stand with walkway and ladder
- j. Centrate sampling assembly
- k. All equipment, components and appurtenant items shall be furnished and installed as complete assemblies. The interconnecting wiring, conduit, piping shall be furnished by others

1.05 Conditions of Service

- A. Sludge dewatering equipment and appurtenances are to be installed in areas of a heated building specifically designed for these systems.
- B. Equipment and its appurtenances shall be suitable for exposure to splash and spill conditions, and 100% humidity.
- C. Equipment and its appurtenances shall be capable of receiving, conditioning and dewatering the feed sludge specified herein, and discharging the dewatered sludge into the sludge pumps, conveyors or gravity discharge chutes as the case may be. Each unit shall be capable of operating continuously and shall be suitable for dewatering the specified sludge continuously for up to 24 hours per day, 7 days per week.

1.06 Design and Performance Criteria

- A. Feed sludge will have the following characteristics:

Sludge Feed Characteristics	Value
Sludge type	Anaerobically Digested Blended Sludge
Normal/ Design Operating flow, gpm (excluding polymer flow)	184 average
Max Operating flow, gpm (including polymer flow)	225
Sludge Concentration, %:	Average 3.2 Max 4.5
Solids loading, lbs/hr	3,300 dry lbs/hr
Max Volatile Solids Concentration, %:	73
SVI:	Unknown
Temperature, F:	95-105
Max Soluble Ortho-Phosphate Concentration (mg/L as P)	20
pH:	7-8

Operating hours/day, days/week	8 hrs/day; 5 days/week
Age of sludge; HRT/SRT, days	Unknown

1.07 Performance Requirements

- A. Each Centrifuge shall achieve the following performance during guaranteed performance acceptance test (GPAT) for the sludge having the characteristics listed under Article 1.03.D above.

Dewatering Performance	
Parameter	Value
Number of installed centrifuges	2
Minimum internal bowl diameter, inches	21.5
Minimum bowl length (cylindrical portion), inches	94
Minimum centrifugal force at wall	3000
Hydraulic loading (including polymer), gpm	225 (max)
Min percent solids capture, %	95
Minimum cake dryness, %	20%
Maximum polymer dosage, active lbs/ton dry solids	30
Maximum noise, dBa	90
Maximum Vibration, mm/s	15
Maximum wash water demand per unit, gpm	60 gpm

1.08 Submittals

- A. Shop drawings, catalog cut sheets, and other materials required to completely describe and specify the system and equipment shall be submitted to ENGINEER for review. These will include:
1. Submission of certified shop and erection drawings, including complete motor data.
 2. Foundations, installations, and grouting.
 3. Services of manufacturer's representative.
 4. Operating and maintenance instructions and parts lists.
 5. Lubricants.
 6. Special tools.
 7. Bolts, anchor bolts, and nuts.

8. Sleeves and inserts.
 9. Electric motors.
 10. Voltage rating of motors.
 11. Equipment drive guards.
 12. Vibration isolators.
 13. Nameplates.
 14. Noise level data.
- B. Detailed shop drawings include, but not necessarily limited to:
1. Detailed drawings and specifications of all items of equipment showing all pertinent dimensions, parts, and construction details and materials, and installation details and requirements.
 2. Performance specifications of all items of equipment.
 3. Instrument layout of control panels.
 4. Complete instrumentation and control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls, and electrical components. Specifically, the following required:
 - a. Complete instrumentation and control schematics.
 - b. Complete electrical circuit schematics, including all motor control, alarms, and power to motors and accessories such as analytical instruments, etc. Schematics include termination points in various panels. Every circuit assigned circuitry number; every wire assigned wire number. In schematics, wiring is identified by numbers. Also, in schematics, every termination point assigned number, and number or identifier assigned to each terminal strip. Both terminal point number (including wire number) and terminal strip identifier appear on the schematics for each wiring termination shown.
 - c. Complete electrical instrumentation and control schematics of control panels and field junction boxes. (Note these are to be supplied prewired.) Schematics to provide complete information on terminal strips and panel instruments.
- C. Certified shop testing results as set forth under Article 1.09 of this Section.
- D. Certified acceptance test results.

1.09 Quality Assurance

- A. Centrifuge Manufacturer Qualifications:
1. Centrifuge manufacturer must have at least 10 years of experience in the United States in the design, application, and supply of centrifuge systems.

2. Qualifying installations and references must be for centrifuge dewatering of municipal wastewater sludge at municipal wastewater treatment plants. Installations and references for dewatering industrial or drinking water sludge will not meet the requirements.
3. Centrifuge manufacturer must have a repair facility in North America that has the necessary equipment to rebuild bowl and scrolls and stocks Centrifuge spare parts.
4. An officer of the Company is required to sign an Affidavit Confirming the Company Officer has completely read the specification and takes no exception or if exceptions are taken they must be listed in the Proposal prior to bid day.

B. Workmanship and Design:

1. The centrifuge manufacturing facility shall be ISO 9001:2015 certified.
2. All parts of the equipment provided to be designed and manufactured for long, continuous and uninterrupted service. All materials to be used are of best quality and entirely suitable for service required.
3. Provisions to be made for easy lubrication, adjustment or replacement of all serviceable parts. A minimum clearance of three feet around all sides of the equipment is required for proper maintenance.
4. Centrifuge assembly shall be designed to assure easy disassembly of the unit, including removal of the rotating assembly vertically, within the space and headroom provided.
5. The corresponding parts of multiple units if applicable shall be interchangeable.

1.10 Warranty

- A. The centrifuge manufacturer shall warrant all equipment supplied to be free of defects in material and workmanship for a period of one year from Construction Acceptance of centrifuge as defined above. Warranty shall cover all labor and material necessary for repairs for all system components and controls furnished by the centrifuge manufacturer. Additionally, the centrifuge manufacturer shall warranty the bowl of the centrifuge for a period of 15 years from Construction Acceptance of centrifuge.
- B. CONTRACTOR shall guarantee all Work for a period of one year from Construction Acceptance of centrifuge as defined above. CONTRACTOR shall furnish at his sole expense, all labor, material, and equipment necessary to correct any defect in material, equipment, installation, and/or workmanship which becomes evident within one year of Construction Acceptance for centrifuge.

1.11 Testing, Maintenance and Service

- A. Shop Test:
 1. Upon completion of manufacture of centrifuge and appurtenances to be installed on this project, conduct shop tests which shall be performed and may be witnessed by ENGINEER as outlined below:
 - a. Centrifuge:

- (1) Running test: Each machine, shall conduct a dry run for a minimum of 8 hours of continuous operation at proposed design operating speed.
- (2) Demonstrate that all equipment is capable of continuous operation in satisfactory manner without mechanical defects or operational difficulties. Measure and record vibrations and temperature of the main bearings.
- (3) If necessary, tests repeated until satisfactory results are obtained.
- (4) All defects or defective equipment revealed by or noted during tests to be corrected or replaced promptly at no additional compensation.

B. Service Centers

1. Centrifuge manufacturer must have a currently operating service center located within the United States.
2. Centrifuge manufacturer must have at least two service technicians who are based at the United States service center, who have been trained specifically on the centrifuge system required for this project, and who would be available for a field service call at the WPCF within 48 hours of written notice.
3. Centrifuge manufacturer's service center must be capable of delivering spare parts, excluding bowls and scrolls, to the WPCF within 48 hours of notice.
4. Manufacturer shall submit documentation and references to demonstrate the ability to provide replacement scrolls/bowl assembly within 10 days from a minimum of two authorized Service Centers located in the United States.

1.12 Delivery, Storage And Handling

- A. Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

Part 2 Products

2.01 General

- A. Equipment specified herein shall be furnished by sludge dewatering equipment manufacturer, who shall assume complete responsibility for conformance to the design documents.
- B. Like items of equipment shall be the product of one manufacturer to achieve standardization of operation, spare parts, maintenance and manufacturer's service.
- C. Manufacturer's standard equipment sizes shall be used unless otherwise specified. The equipment provided shall be complete in all respects including, but not limited to, initial lubricants, components, calibration, alignment, and adjustments as necessary to place the equipment in operation to perform its intended functions.

2.03 Manufacturers

- A. Sludge dewatering equipment shall be manufactured by Centrisys Corporation or ENGINEER Preapproved Equal. The cost of any additional engineering required to accommodate the selection of an alternate manufacturer will be covered by the manufacturer with no additional cost to OWNER.

2.04 Materials of Construction/Equipment

- A. General:
 - 1. Unless otherwise specified all parts of the centrifuge in contact with the sludge shall be made of 304 or 316 stainless steel, except O-ring, seals or abrasion resistant materials.
 - 2. O-ring and seals shall be manufactured of the following:
 - a. O-ring: Viton
 - b. Lip Type Seals: Viton
 - 3. Guards shall be constructed of powder coated carbon steel
- B. Centrifuge Assembly:
 - 1. Bowl:
 - a. Bowl shall consist of a horizontal cylindrical-conical assembly. The cylindrical and conical sections must be bolted together. One-piece bowls shall not be acceptable. Solids are discharged at the small end of the conical section. The bowl shall have a minimum diameter of 20.5 inches of I.D. and a minimum length of 94 inches with a minimum length: diameter ratio of 4:4 and maximum beach angle of 15 degrees. It shall be supported by roller bearings mounted in pillow blocks. Beach angles that are less or more than 15 degrees shall not be acceptable.
 - b. Design to operate at a maximum of 3,000 Gs at the bowl wall for maximum process flexibility and reliability and to withstand all centrifugal forces encountered at design operating speed with adequate safety factors of at least 2.0. Inspect bowl for cracks, shrinkage, porosity, or other defects, by means of a liquid dye penetrant test.
 - c. G-volume of the centrifuge shall be a minimum of 200,000 when calculated at the maximum recommended operating speed. The G-Volume shall be calculated as defined in Article 1.04.5
 - d. Bowl shall be centrifugally casted . All centrifugal castings shall be inspected for cracks, shrinkage, porosity or other defects, by means of liquid dye penetrate test. The centrifuge bowl shall be centrifugally cast from duplex stainless steel; with a minimum tensile strength of 100,000 PSI (690MPa) Material shall be A890 or 1.4470. Rolled, welded or Static cast bowls are not acceptable.
 - e. Minimum acceptable thickness for the cylindrical and conical sections of the bowl wall shall be 0.7 inches to achieve a minimum safety factor of 2.0.

- f. Liquid pool depth in the bowl shall be adjustable through the use of weir plates at the large diameter end of the bowl where liquid is discharged. Solids shall be discharged from the small diameter end of the bowl. The plate dams shall be manufactured from 304 stainless steel.
- g. Bowl wall, both cylindrical and conical, shall be protected by longitudinal wear strips which cause formation of protective feed solids layer so that the solids slip on the scroll flights and adhere to the bowl wall for proper transportation. Machined grooves, that can cause accelerated wear, require conical machining or replacement when worn or Astro turf that often comes loose are not acceptable.
- h. The solids discharge ports shall be protected by specially designed raised inserts hard surfaced with tungsten carbide.
- i. Sludge feed shall be introduced into the centrifuge feed zone by means of a 2-inch diameter 304L stainless steel feed pipe from the solids end. The liquid end feed design is not acceptable. The feed shall be uniformly distributed into the centrifuge and the feed zone.

2. Scroll Conveyor:

- a. Centrifuge shall include a horizontal cylindrical-conical scroll conveyor supported by grease lubricated cylindrical roller bearings and grease lubricated angular contact anti-thrust ball bearings and equipped with helical flights independently mounted concentrically within the centrifuge bowl. Conveyor hub shall be cast Duplex SS. All conveyer hubs shall be inspected for cracks, shrinkage, porosity or other defects, by means of liquid dye penetrant testing. Manufactured hubs are not acceptable.
- b. Scroll shaft shall be Duplex SS and flights shall be type 304SS
- c. Conveyor bearings shall be protected by specially designed anti-centrifugal seals or mechanical metal face seals with an elastomer spring element and shall be manually lubricated by means of a manual grease lubrication system. O-ring seals are not acceptable for the conveyer bearings.
- d. Cylindrical section of the scroll conveyor shall be of the quasi axial flow design. Solid helical screw conveyors shall not be accepted.
- e. Scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool.
- f. Feed chamber should have a minimum of 18 feed ports which should cover an area no less than 190 in² to assure uniform introduction of feed into liquid pool with lowest velocity and therefore least disturbance of settled solids. Ports should be raised to minimize wear and shall be protected from abrasion by tungsten carbide coating and self-generated sludge liner. Feed nozzles or ports shall be protected by Tungsten carbide.

- g. Edge and face of the conveyor flights shall be protected against abrasion with hard surfacing material, from the feed zone to the liquid discharge end. Hard surfacing shall be guaranteed against failure for 15,000 hours of operation.
- h. Edge and face of the conveyor flights shall be protected against abrasion with TC tiles, from the feed zone to the solid discharge. Hard TC tiles shall be guaranteed against failure for 15,000 hours of operation.
- i. Centrifuge should be able to operate both leading and lagging for better operation and reduction of wear and longer life of bowl and scroll wear protection.

3. Casing:

- a. Centrifuge casing shall consist of a 304 or 316 stainless steel lower casing and a one-piece upper casing. The purpose of the case shall be to contain and direct the solids and liquid discharge from the centrifuge, to act as a protective guard and to provide a complete enclosure for noise reduction. Stainless lined fiberglass or Fiberglass covers and guards not acceptable.
- b. Lower casing shall be constructed with all process contact material of 304 or 316 stainless steel. The upper casing shall be manufactured of 304 or 316 stainless steel.
- c. Casing shall be a single piece to cover the entire rotating assembly and manufactured of stainless steel.
- d. A system will be provided as specified to limit the noise generated by the centrifuge to 88 dBA or less 1 meter from the centrifuge frame.
- e. Centrifuge case shall be vented as recommended by the manufacturer. Lifting hooks shall be provided for lifting the casing.
- f. To limit splashing and air leakage, the casing shall be provided with labyrinth seals where the bowl hubs intersect the casing and a gasket on the machine flanges where the upper and lower casings join.

4. Base:

- a. Centrifuge shall be supported on a fabricated carbon steel or cast-iron base fusion bonded powder coat finish and 304 or 316 stainless steel wetted parts. The base shall be mounted on vibration isolators.
- b. Machined surfaces shall be provided at all points where support loads are transferred to the base. The bottom portion of the base shall be provided with machined outlets for the attachment of the solids and centrate flexible connectors and chutes and other appurtenant connections.
- c. Lifting hooks or solid lifting bars shall be provided for lifting the base.

5. Main Bearings:

- a. The main bearing shall be pillow block ball type. The bearings shall have an L-10 life of 100,000 hours minimum at 24 hours per day service.

- b. The main bearings shall be lubricated by an automatic grease lubrication system.

C. Main Drive Motor:

- 1. The main drive motor shall be designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards and have the following characteristics:
 - a. Type: Squirrel-Cage, Single-Speed
 - b. Max Horsepower: 75 HP
 - c. Synchronous Speed: 3600 rpm
 - d. Service Factor: 1.15
 - e. NEMA Design: B
 - f. Insulation Class: F or H
 - g. Code Letter: G
 - h. Voltage: 460 volts
 - i. Phase: 3-phase
 - j. Ambient Temperature Rating: 40 degrees C
 - k. Maximum Temperature Rating: 120 degrees C
 - l. Mounting: Horizontal
 - m. Enclosure: TEFC
 - n. Duty Cycle: Continuous
 - o. Starting Method: Reduced voltage
 - p. Bearing Life: 100,000 Hrs. as defined by AFBMA B-10 Standard
 - q. Full Load: Not less than 94 percent
 - r. Efficiency: Power factor of 0.88
 - s. Sound Level: Maximum 85-89 dBA at 3 feet
- 2. Minimum size motors are required to be installed on the Centrifuge and if a larger service must be installed, this will be paid to OWNER.

D. Scroll Drive System:

- 1. Hydraulic Scroll Drive system shall be supplied with each centrifuge to provide speed variation between the conveyor and the bowl.
- 2. Hydraulic scroll drive system. The differential speed between the centrifuge bowl and scroll conveyor shall be produced by maximum 15 HP, water- or air-cooled hydraulic system which shall independently drive the scroll conveyor. The hydraulic scroll conveyor drive system shall be designed such that no mechanical gear reducer is required in the scroll conveyor drive train. The hydraulic drive system shall be capable of operating in either a manual or automatic mode. In the manual mode it shall provide for operation at a specific, adjustable scroll differential speed with internal torque allowed to vary up to the maximum allowable scroll shaft torque.
- 3. In the automatic mode it shall continuously monitor changes in internal torque created by variations in influent feed solids and automatically maintain a proper filling level by allowing the differential speed and torque to vary. The hydraulic drive shall operate in a manner such that, as the reactive torque of scroll shaft increases due to an increase in solids inventory in the bowl, the scroll differential speed shall gradually increase and, conversely, as the inventory of solids in the bowl and resultant reactive torque decreases, the scroll differential speed shall decrease. The net effect of this system, when operated in the automatic mode,

shall be to maximize the time that cake solids are under the influence of accelerated gravitational force to ensure that the driest possible dewatered cake product is produced without plugging the centrifuge.

4. System shall use a hydraulic pumping group and hydraulic motor. Torque-based adjustment shall be a function of input to the driven unit. The maximum torque input and rate of change of scroll differential speed shall be adjustable.
5. System shall be designed such that automatic centrifuge shutdown is initiated in the event that excessive torque is detected. Two (2) sets of contacts shall be provided.
6. In the event that torque exceeds the normal operating range, the sludge feed pump shall be automatically stopped to allow the centrifuge to clear itself and shall automatically restart when the torque drops to the normal operating range. In the event that the torque approaches the limit of the drive, the second set of contacts shall automatically initiate shutdown of both the feed pump and centrifuge. In this instance manual reset of the alarm is required before the centrifuge can be restarted
7. In case of a high torque shutdown, the scroll drive should not trip but maintain full torque for the entire shutdown so that the machine clears itself while under reduced G-force, therefore it is clean when coming to a complete stop.
8. Hydraulic Pump Unit shall be provided with 18-inch steel stand to aid in oil changes.
9. Scroll drives should be designed such that if needed, they should be replaced without removing and dismantling the rotor.
10. No mechanical gear reducers such as planetary or cyclo gears are to be used in the scroll conveyor drive train.
11. Scroll drive system must be designed to offer cleaning capabilities while the centrifuge bowl is at a standstill.
12. Maximum torque and maximum differential speed shall be available with the bowl at a standstill.
13. After power failure, with machine fully loaded with solids, scroll drive system must be capable of maintaining differential speed without accelerating the bowl.
14. Scroll drive system shall be able to run the scroll only without input from the maindrive in plugged conditions. Systems with gear boxes shall require bowl locking devices

E. Vibration Isolators:

1. Equipment manufacturer shall furnish vibration isolators which shall be capable of dampening vibration in all directions created during normal and emergency operation of the equipment.
2. Vibration isolators shall be provided for the centrifuge assembly.

F. Connections:

1. Piping and discharge chute connections to the centrifuge assembly, main drive motor and lubrication system, including but not limited to the feed sludge, wash water, polymer, drain, centrate, discharge sludge discharge and power and control connections, shall be equipped with flexible connections.
2. Flexible connections shall isolate the equipment from fixed rigid piping, chutes or other connections
3. Centrate discharge chute shall be rectangular with a top flange matching the flange of the flexible liquid discharge connection. Chute shall include a 2-inch connection as a vent flange.
4. Chute shall maintain the shape of the centrifuge casing discharge connection and shall be 12-inches long. Chute is to be manufactured from 304 stainless steel.
5. Dewatered sludge discharge chute shall be rectangular with a top flange which matches the flange of the solids flexible discharge connection. Chute is to maintain the shape of the centrifuge casing discharge connection and is to have sides as straight as possible to prevent solids from bridging or hanging up. The chute shall be manufactured of 304 stainless steel.

G. Diverter Gate Isolation:

1. Cake discharge chute shall be equipped with a diverter gate that will prevent cake from falling into the cake pump hopper and shall provide drain connection for slop material upon centrifuge start-up and shutdown.
2. Diverter gate shall have multiple flush water connection points which are to be activated via flush water solenoid (not part of diverter gate) when the gate is closed
3. Diverter gate shall be the centrifuge manufacturers standard type
4. Gate shall be controlled by an electric actuator.
5. Electric actuator shall be Rotork or ENGINEER approved equal.
6. Gate shall remain closed during centrifuge start up such that the high-liquid output will be forced out the centrate opening. The centrifuge manufacturer shall program the actuator parameters such that the knife gate opens after the centrifuge is producing a high-quality cake.

H. Sample Port:

1. Centrate discharge shall be equipped with a sampling assembly complete with collection scoop inside of discharge, a sample tap with valve, and collection funnel which will drain back to the centrate drain line.

I. Rotating Assembly Cart:

1. Centrifuge manufacturer shall provide a 4-wheeled cart designed to safely roll the rotating assembly to a location where it can be loaded onto a truck for shipment.

2.05 Controls

- A. Control panel or motor control cabinet shall be a stainless steel NEMA 4X enclosure. Included with the enclosure shall be:
 - 1. Main circuit breaker,
 - 2. Control power transformer,
 - 3. Variable frequency drive to run the centrifuge main bowl motor,
 - 4. Scroll drive motor starter and proportional valve amplifier
 - 5. Variable frequency drive system for any sludge pumps provided
 - 6. Side-mounted air conditioning unit - used to regulate control cabinet temperature.
 - 7. Polymer control circuits
 - 8. Allan Bradley CompactLogix L30ER PLC
 - 9. Panelview Plus 7 standard edition 10" touchscreen
- B. Through the interface, the operator shall be capable of verifying sludge and polymer actual flow rates from flow meters. The control panel shall be provided with centrifuge feed pump start/stop speed control; polymer feed pump start/stop speed control, scroll drive start/stop control and a cake conveyor start/stop control. Also included shall be bowl drive amp feedback and elapsed time. Pilot lights, pushbuttons, scroll drive starter and alarm system shall be mounted in the door. A PanelView Plus 1000 OIT shall be provided.
- C. Controls for a new polymer system shall be incorporated into this panel.
- D. Components in the control panel shall be completely factory wired. All external control connection points shall terminate on a terminal strip with a minimum of 10% spare terminal connections supplied. All pushbuttons and pilot lights shall be watertight, corrosion resistant and in accordance with current plant standards.
- E. Auxiliary system operation shall be controlled automatically upon starting a centrifuge or manually with individual pushbuttons. Control logic shall be CompactLogix PLC based with ladder logic programming. The system shall provide separate contact outputs for remote indication of centrifuge running. The controls for the feed system will be intergraded into the panel and interlocked. The feed system shall be interlocked against low level, high-pressure low pressure and low polymer.
- F. PLC shall be as manufactured by Allan Bradley.

2.06 Monitoring System

- A. The minimum inputs and shutdown Alarm indications shall be the following:
 - 1. Excessive vibration
 - 2. Excessive main drive motor overload
 - 3. Excessive scroll drive drive motor overload
 - 4. Scroll drive drive malfunction

5. Main Drive malfunction
 6. High-high scroll conveyor torque
 7. Centrifuge bowl overspeed
 8. E-Stop
 9. High-high vibration
 10. High-high bearing temperature
 11. Control Panel high temperature
 12. Lubrication Fault
- B. The following trouble inputs and indications shall be available at the PLC, but not shut down the centrifuge:
1. Feed pump fault
 2. Polymer system fault
 3. Low flow-feed /polymer
 4. High scroll conveyor torque
 5. High vibration
- C. The following inputs and shutdown Alarm indications can be available for optional equipment at the PLC:
1. Main drive motor temperature
 2. Scroll drive motor temperature
 3. Hydraulic cooling Fan aux fault
 4. Other options equipment
- D. The following trouble inputs and indications can be available for optional equipment at the PLC, but shall not shut down the centrifuge:
1. Diverter
 2. Discharge conveyors
 3. Sludge / polymer pump
 4. Other optional equipment

2.07 Painting

- A. Shop and field painting to be manufacturers standard except where indicated otherwise in specifications
- B. **Do not paint the 304SS skid members**

2.08 Spare Parts

- A. The following spare parts shall be furnished with the centrifuges and scroll drive systems:
1. One (1) set - bearings and seals
 2. One (1) set - o-rings and seals
 3. One (1) set - matched drive belts
 4. One (1) year supply of lubricants
 5. One (1) year supply of filters
 6. One (1) spare programmed memory card for PLC

2.09 Special Tools

- A. One set of the following tools will be furnished
 - 1. Set wrenches
 - 2. Bowl lifter
 - 3. Bearing puller

Part 3 Execution

3.01 Factory Test

- A. Supplier to conduct in-factory functional testing of assembled unit.
- B. Supplier to submit protocol for factory test for OWNER review.
- C. Supplier to submit factory test results report for review by OWNER prior to shipment of the assembled unit to the jobsite
- D. Test shall include the following at the minimum.
 - 1. Power skid unit with 480VAC, 60Hz, 3 phase power
 - 2. Test rotation of all motors and drive units
 - 3. Simulate operation conditions and modes to confirm function
 - 4. Simulate all alarm input conditions to verify appropriate alarm indication and shutdown functions
- E. Witnessed Testing:
 - 1. Supplier to provide four weeks advance notice to OWNER of factory test
 - 2. Supplier to allow OWNER, at OWNERs option and cost, to visit supplier's factory test

3.02 Delivery of Equipment

- A. Equipment supplied under this section shall be stored per specification Section 40 0500, General Equipment Requirements, until construction has progressed to the point where installation may properly commence
- B. Protect all equipment per Manufacturer's instructions
- C. Replace any equipment damaged after receipt of equipment at CONTRACTOR's expense

3.03 Installation

- A. Installation to be in strict accordance with the Manufacturer's instruction and recommendations in the locations shown on the Drawings.
- B. All equipment, components, piping and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of CONTRACTOR to the above items shall be repaired or replaced by CONTRACTOR to its original condition.

- C. Interconnecting piping supplied by CONTRACTOR to be hydrostatically tested by CONTRACTOR.
- D. Centrifuge system Manufacturer's representative to be present during placement and connection of the unit to power and liquid connections to instruct and observe installation.
- E. Centrifuge Manufacturer's representative to inspect the installation prior to startup in order to verify that the equipment has been properly installed.
- F. Centrifuge system Manufacturer's representative to calibrate the equipment with OWNER's operator present after installation prior to startup.

3.04 During Installation by CONTRACTOR

- A. Provide installation instruction manuals for CONTRACTOR's assistance at least 30 days prior to shipment of factory assembled treatment units
- B. Provide general assistance regarding handling, assembly and installation requirements for complete installation by CONTRACTOR
- C. Verify all equipment installed per manufacturer's recommendations and literature and the Drawings.

3.05 Field Quality Control

- A. Service:
 - 1. Qualified service personnel must be available on 24 hours a day basis
 - 2. The personnel must be completely familiar with the items supplied so as to return inoperative equipment to service in the shortest possible time
 - 3. The pre-qualification information is to include the following:
 - a. Name, educational background and years of service experience for all service personnel
- B. Tests:
 - 1. Field testing and checking of installation to be approved by Manufacturer's field representative
 - 2. Test under full load conditions
 - 3. Verify that all control system functions, including alarms, perform as specified
 - 4. Any spare parts furnished as specified but used during startup must be replaced prior to final acceptance
 - 5. Manufacturers field representative to perform field test
 - 6. An independent lab is required to test all samples and the Centrifuge Company is to pay for this while OWNER selects the lab.

7. If equipment fails to meet performance specifications, the manufacturer, at no cost to OWNER, shall modify, replace, and otherwise do whatever is necessary to provide equipment that will pass the equipment testing specification.

C. Manufacturers Field Services:

1. Qualified factory-trained representative to provide startup and operator training services. Representative to be available within two (2) weeks of request for services. Representative to provide following services:
 - a. Equipment installation review and certification of proper installation: Provide one (1) trip; minimum of four (4) eight 8-hour days onsite for initial visit to checkout installation and verify that centrifuge system is ready to operate.
 - b. Startup and optimization: Provide a minimum for four (4) 8-hour days over one trip for optimization and performance testing of equipment.
 - c. Operator training: Provide one (1) trip of minimum two (2), 8-hour days to provide classroom training of operating personnel in the operation of centrifuge system and to provide “hands-on” training for operation of equipment
 - d. Six (6) month performance review and post startup training: One (1) trip of 8-hours minimum to make operating adjustments and provide additional instruction to OWNERS personnel within 6 months after final acceptance of equipment

End of Section

Exhibit 1

Project Forms

1. Certificate of Substantial Completion
2. Change Order
3. Change Proposal
4. Construction Change Requisition / Work Change Directive
5. Field Order
6. Non-Compliance Notice / Order to Remove Defective Work
7. Open Items List
8. Punch List Items
9. Request for Final Inspection
10. Request for Information
11. Substitution Request Form
12. Warranty Data Sheet
13. City of Flint Material Disposal Form



CERTIFICATE OF SUBSTANTIAL COMPLETION

350-02

(Rev. 04/2019)

CLEAR FORM

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

Contract Date.: _____

Date of Issuance: _____

Project or Designated Portion Shall include:

The Work performed under this Contract has been reviewed and found to be Substantially Complete. The date of Substantial Completion of the Project or portion thereof designated above is hereby established as _____, which is also the date of commencement of applicable warranties required by the Contract Documents except as stated below.

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The date of Substantial Completion of the Work or designated portion thereof, is the date certified by ENGINEER when construction is sufficiently complete, in accordance with the Contract Documents, so OWNER can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, which has been prepared by ENGINEER, is attached hereto. The failure to include any items on such list does not alter the responsibility of CONTRACTOR to complete all Work in accordance with the Contract Documents. The date of commencement of warranties for items on the attached list will be the date of final payment unless otherwise agreed to in writing.

The responsibilities of OWNER and CONTRACTOR for security, maintenance, heat, utilities, damage to the Work and insurance shall be as follows:

(Note - OWNER's and CONTRACTOR's legal and insurance counsel should determine and review insurance requirements and coverage; CONTRACTOR shall secure consent of surety company, if any.)

OWNER shall have 45 days after receipt of this certificate during which he may make written objection to ENGINEER and CONTRACTOR as to any provisions of the certificate or attached list. Such objection may be cause for this Certificate of Substantial Completion to be null and void.

Engineer's Signature

Print Name _____

Date _____



CLEAR FORM

CHANGE ORDER NO. _____

305.08
(Rev. 04/2019)

Prepared By: _____

Date of Issuance: _____

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

The Contract Documents are modified as follows upon execution of this Change Order:

Attachments: (List documents supporting change):

CHANGE IN CONTRACT PRICE

Original Contract Price:

\$

Select 1 from previously approved Change
Orders No. to No. :

\$

Contract Price prior to this Change Order:

\$

Select 1 of this Change Order:

\$

Contract Price incorporating this Change Order:

\$

CHANGE IN CONTRACT TIME

Original Contract Times:

☐ Working Days ☐ Calendar Days

Substantial Completion (date):

Ready for final payment (date):

Select 1 from previously approved Change
Orders No. to No. :

Substantial Completion (days):

Ready for final payment (days):

Contract Times prior to this Change Order:

Substantial Completion (date):

Ready for final payment (date):

Select 1 of this Change Order:

Substantial Completion (days):

Ready for final payment (days):

Contract Times with all approved Change Orders:

Substantial Completion (date):

Ready for final payment (date):

RECOMMENDED:

By: _____
Engineer (Authorized Signature)

Date: _____

ACCEPTED:

By: _____
Owner (Authorized Signature)

Date: _____

ACCEPTED:

By: _____
Contractor (Authorized Signature)

Date: _____

Change Order becomes effective upon date of final signature.



CLEAR FORM

CHANGE PROPOSAL NO. _____

305.01
(Rev. 04/2019)

Prepared By: _____

Date of Issuance: _____

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

This Change Proposal is submitted in accordance with Paragraph 10.06 of the General Conditions.

If this Change Proposal is accepted, either in whole or in part, a Change Order will be issued to modify the Contract Documents accordingly.

Detailed Description of Proposed Change:

Attachments: (List documents attached supporting requested change):	
<u>CHANGE IN CONTRACT PRICE</u> Select 1 of this requested Proposal: \$ _____	<u>CHANGE IN CONTRACT TIME</u> Select 1 of this requested Change Proposal: Substantial Completion (days): _____ Ready for final payment (days): _____

Engineer's Decision on Change Proposal:

ENGINEER: By: _____ <i>Engineer (Authorized Signature)</i> Date: _____	OWNER: By: _____ <i>Owner (Authorized Signature)</i> Date: _____	CONTRACTOR: By: _____ <i>Contractor (Authorized Signature)</i> Date: _____



☐ CONSTRUCTION CHANGE REQUISITION
☐ WORK CHANGE DIRECTIVE

No. _____
(continued)

Date: _____

Page: _____ of _____

Work Order Authorization: ☐ Approved ☐ Approved as Noted ☐ Not Approved

If authorized, the Contractor agrees to do the work outlined above under the direction of the Engineer, and to accept as payment in full the basis of payment as indicated.

Contract Time: ☐ Add Time Extension of _____ Days ☐ Not Applicable

Accepted By: _____
Contractor (Representative) _____ Date _____

Recommended By: _____
Wade Trim (Representative) _____ Date _____

Approved By: _____
Owner (Representative) _____ Date _____



FIELD ORDER NO. _____

305.04

(Rev. 04/2019)

CLEAR FORM

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	
Date:			
Prepared by:			
Subject / Description:			

Classification: ☐ Clarification or ☐ Interpretation of Contract Documents
☐ Minor Change in Work Which Does Not Involve Contract Price or Contract Time
☐ Minor Change in Addition to Work

Reason:_____
Resident Project Representative Date_____
Contractor's Authorized Representative Date



NON-COMPLIANCE NOTICE / ORDER TO REMOVE DEFECTIVE WORK NO. _____

330.06
(Rev. 01/2018)

Job No.: _____

Date: _____

Project: _____

Time: _____

Attention: _____

You are hereby notified that:

_____ does not conform to the Contract Requirements. The Specification violated in Section _____, Article _____, Drawing No. _____. Under the provisions of the Contract, the requirements are _____

☐

Non-complying work may be required to be removed and replaced at no cost to the Owner.

☐

Non-complying work may be removed and replaced at no cost to the Owner. No work shall continue until the defective work has been removed.

It shall be the Contractor's responsibility to determine the corrective action plan necessary to bring the work into compliance. This action plan shall be submitted to the Owner and his authorized representative for their review and concurrence that said corrective action will adequately address the deficiency. If you refute the initial findings, it is your responsibility to make your position known to the Owner and his representative with sufficient documentation that your position can be evaluated. All actions described above shall be done in writing as near to the date of the Notice as possible, but no later than ten (10) days after the issuance of said Notice.

Resident Project Representative (Signature)

Non-Compliance Notice Received By Contractor

Received On: _____
Date

By: _____
(Signature)

Title: _____

Corrective action to be taken by Contractor: _____

Date

By: _____
(Signature)

Owner's Acknowledgement

☐ Accepted

☐ Accepted as Noted

☐ Unacceptable

☐ Pricing

Date

By: _____
(Signature)

OPEN ITEMS LIST

350.01

(Rev. 01/2019)

Page: _____ of _____

Construction Start Date: _____

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:			Subcontractor:

[illegible]

Close out of all items verified by Field Engineer: _____ **Signature:** _____ **Date:** _____

Comments:

- 1) This Open Items List is to be immediately inserted in the Inspection folder for each assignment by the assigned Inspector or the assigned Field Engineer.
- 2) Anyone can make entries on this list, but each entry must be initialed and dated. Item(s) entered must be reported to the assigned Field Engineer immediately.
- 3) Action to be taken should be confirmed with the assigned Field Engineer.
- 4) Verification for completion can be initialed and dated by the assigned Inspector but must also be verified by the assigned Field Engineer.
- 5) This form is not contractual to contract completion.

CLEAR FORM



REQUEST FOR FINAL INSPECTION

350.06
(Rev. 04/2019)

CLEAR FORM

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

The project to which this request applies has been inspected by authorized representatives of CONTRACTOR and ENGINEER, and the Work is hereby declared to be substantially complete to a point that a project punch list should be prepared in accordance with the following schedule:

Develop Preliminary Punch List

Date: _____

Responsibility: Owner, Contractor and Engineer
Engineer shall have 2 weeks to prepare the punch list.

Complete Preliminary Punch List Items

Date: _____

Responsibility: Contractor
Contractor shall have 2 weeks to complete the items on the punch list.

Develop Final Punch List (if needed)

Date: _____

Responsibility: Owner, Contractor and Engineer
If needed, a second and final punch list will be prepared within 2 weeks by Engineer.

Complete Final Punch List Items

Date: _____

Responsibility: Contractor
Contractor shall have 2 weeks to complete the items on the second and final punch list.

Process Final Payment

Date: _____

Engineer will have 2 weeks to review and submit final pay request documents from Contractor to the Owner for final payment upon satisfactory completion of punch list items by Contractor.

This notice signed and dated through mutual agreement of CONTRACTOR and ENGINEER will initiate the time sequence for the approved execution of finalizing _____

Contract in _____, Michigan, dated _____.

COPY: OWNER

Date: _____

ENGINEER's Representative

Date: 02/02/2019

CONTRACTOR's Representative

[Contractor to
Insert logo here]

REQUEST FOR INFORMATION (RFI) NO. _____

311-01
(Rev. 04/2019)

CLEAR FORM

Page: 1 of

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

RFI Subject:			
Division:		Spec Section:	
Plan Sheet No(s).:			
Date Received:		Requested Response Date:	
Returned to Contractor:			

Is there potential for effects to the Contract?

Contract Price Impact: [Select 1](#)

Contract Schedule Impact: [Select 1](#)

Information Requested

Attachments

Response**Attachments**

Response by: _____ Date: _____

THIS REPLY IS GIVEN WITH THE EXPRESSED UNDERSTANDING THAT IT DOES NOT CONSTITUTE BASIS FOR CHANGE IN PRICE OR TIME OF THE CONTRACT UNLESS OTHERWISE INDICATED.



REQUEST FOR INFORMATION (RFI) NO. _____ RESPONSE

CLEAR FORM

311-01
(Rev. 04/2019)

Page: 1 of _____

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

RFI Subject:			
Division:		Spec Section:	
Plan Sheet No(s).:			
Date Received:		Requested Response Date:	
Returned to Contractor:			

REVIEWER INFORMATION

Reviewed By:	
Email:	
Phone:	

RESPONSE:

Attachments

Response by: _____ Date: _____

THIS REPLY IS GIVEN WITH THE EXPRESSED UNDERSTANDING THAT IT DOES NOT CONSTITUTE BASIS FOR CHANGE IN PRICE OR TIME OF THE CONTRACT UNLESS OTHERWISE INDICATED.



SUBSTITUTION REQUEST FORM

310.06
(Rev. 04/2019)

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	

Specification Section: _____ Article No.: _____
 Specified Product: _____
 Proposed Substitution: _____

Does specified product exceed in any respect, proposed substitution?	☐ Yes	☐ No
Does substitution affect dimensions shown on Plans?	☐ Yes	☐ No
Does substitution affect other trades more than original product?	☐ Yes	☐ No
Does warranty differ from that specified?	☐ Yes	☐ No
Does substitution affect cost to OWNER?	☐ Yes	☐ No
Does substitution result in any license fee or royalty?	☐ Yes	☐ No

If you indicated "Yes" to any of the items above, attach thorough explanation for the following:

1. Explain any differences between proposed substitution and specified product.
2. Summarize experience with product and manufacturer in Project area.
3. Attach complete technical data and literature.

The undersigned states that the function, appearance, and quality of the proposed substitution is equivalent or superior to the specified item, and that all information above and attached is true and correct.

Submitted by: _____ Date Submitted: _____
 Company: _____
 Address: _____
 Telephone: _____ Email: _____
 Signature: _____

ACTION STATUS	
ENGINEER'S REVIEW	RESPONSE REQUIRED OF CONTRACTOR
1. Approved (A) ☐	None ☐
2. Approved as Noted (AN) ☐	Confirm ☐
3. Revise and Resubmit (RR) ☐	Resubmit ☐
4. Not Approved - See Remarks (NA) ☐	
Engineer's review is for general conformance with the design concept and contract documents. Markings or comments should not be construed as relieving the contractor from compliance with the project requirements, nor departures therefrom. The contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.	
WADE TRIM (XXX) XXX-XXXX	XXXXXXX City, State ZIP
By: _____ Date: _____	



WARRANTY DATA SHEET

350.07
(Rev. 04/2019)

CLEAR FORM

Date: _____
Page: _____ of _____

WT Project No.:		Project Name:	
Owner / Municipality:			
Owner Project No.:		Department:	
Project Location:			
Contractor:		Subcontractor:	
Contractor Address:		Phone:	

Project Description:

Supplier/Vendor: _____ Phone: _____
Address: _____

Manufacturer: _____ Serial No. _____

Manufacturer Part No.: _____ Asset / Part Name: _____

Location: _____ Owner ID No.: _____

Warranty Provider: _____

Warranty Type (labor, parts, parts and labor, etc.) _____

Warranty Description:

Warranty Class/Limitations: ☐ Limited ☐ 1 year ☐ 2 year
☐ Other: _____

Warranty Date: _____ Initial Reading: _____

Warranty Expiration Date: _____ Maximum Reading: _____

Exclusions:

Comments:

Attachment: Copy of Warranty

Exhibit 2
MAK Controls Process Integration Proposal

City of Flint
Flint, Michigan
WPCF 2020 Projects

Sludge Dewatering

MAK-2006

MAK: Michael Lancina
MAKcontrolsLLC@gmail.com
(734) 770-8785

City of Flint: John Florshinger
jflorshinger@cityofflint.com
(810) 577-8909



ELECTRICAL ENGINEERING | CONTROLS DESIGN
PANEL FABRICATION | PROJECT MANAGEMENT

MAK-2006 Dewatering System Features & Functions



Scope

Provide engineering support to integrate the process changes necessitated by the work associated with the Sludge Dewatering Improvement project.

Justification

The new Dewatering and Solids Handling equipment will be supplied as separate, engineered systems.

These separate systems need to be integrated into a single system, remotely monitored from the Administration building.

Description

MAK Controls will provide engineering and configuration services as part of this project. Hardware, Software and installation services are provided by others. Those services will include:

Engineering support to integrate the Centrifuge and Solids Handling control panels into the existing Allen-Bradley based supervisory control system. This includes network design and modifications to the CompactLogix controllers.

Develop a set of graphics in the WPC's FactoryTalk View environment that mimics all of the supplied PanelView graphics (from the Centrifuge and Solids Handling systems). These graphics will include any necessary 'overview' graphics.

Develop and implement a coordination and interlock scheme to support automation of the process.

Develop and configure an Alarm and Events recording scheme to support operations.

Payment Terms

MAK Controls requests the following payment terms:

Contract Award - 50%

Project Complete - 50%

The following is a lump-sum proposal for this project:

\$27,770.00

MAK-2006 Dewatering Terms and Conditions



The terms and conditions stated below shall become a part of any service agreement or contract including services by MAK Controls LLC (hereinafter "MAK Controls")

1. COMPENSATION:

Unless otherwise agreed to by MAK Controls, the Purchaser will pay MAK Controls for services rendered which shall be invoiced at the hourly rates applicable to the type of service(s) provided by the MAK Controls employee(s) during the billing period. Services shall include the travel spent to Purchaser's place of business from the office or home of the MAK Controls employees. Purchasers shall reimburse MAK Controls for reasonable out of pocket expenses as defined in Section 8. Payments must be made in full within 30 days of the dates of the invoices.

2. TAXES AND OTHER CHARGES:

The Purchaser shall pay MAK Controls an additional amount equal to any taxes, duties or charges by any governmental or quasi-governmental authority which accrues due to this contract except for taxes on net income.

3. SCOPE CHANGES:

Any changes in the scope of order other than for services or any material change in the scope of an order for services must be documented in writing by the Purchaser and subject to incorporation in the original agreement by written approval by an Officer of MAK Controls. Any of these changes authorized by Purchaser may result in price, delivery and/or condition changes. Price changes shall be on the then current rates.

4. NORMAL WORK DAY:

The normal workday shall be an eight (8) hour day shift excluding Saturdays, Sundays and holidays observed by MAK Controls.

5. OVERTIME:

Any service or travel not performed or done during a normal workday shall be invoiced at MAK Controls's overtime rate only when agreed to by Purchaser.

6. SHIFT WORK:

When shift work (eight (8) hour shifts other than the normal work day) is required, a twenty percent (20%) premium shall be added for service during the other shifts. Overtime rates plus twenty percent (20%) shall be applicable for work in excess of eight (8) hours during these other shifts.

7. ADVANCED COMMITMENTS:

Service time committed in advance by MAK Controls on the basis of a pre-specified number of days shall not be deemed to include overtime or shift work. If overtime or shift work is required on such commitments, the pre-specified time so committed in advance shall be appropriately reduced.

8. EXPENSES:

Unless otherwise agreed upon in writing, Purchaser shall reimburse MAK Controls for expenses as follows:

- A. Automobile travel expenses shall be reimbursed on the basis of the current IRS approved standard mileage rate.
- B. All other travel and living expenses shall be reimbursed at cost.
- C. Applicable communication expense accrued on the job shall be reimbursed at cost.

Travel time and expenses shall accrue from the point of origin. Airline travel shall be at Coach class unless Purchaser's needs versus seat availability dictates otherwise. Living accommodations shall be of business class quality unless unavailable in which case the next best available accommodations shall be selected.

9. DELAYS

Unless the MAK Controls representative has been released from the jobsite, or has completed his assignment, the Purchaser will pay MAK Controls charges computed as if the MAK Controls representative was working a normal work week, regardless of whether or not the representative is prevented from working due to delays beyond this control. Release from the jobsite shall entitle the representative to return to his point of origin, with travel time and expenses for the account of Purchaser.

10. STANDBY TIME:

Standby time is defined as the time during which a MAK Controls representative is requested to remain in readiness and available for work commencing at the convenience of the Purchase. Such time shall be considered as time worked, whether or not the representative is at the jobsite, and Purchaser will be billed accordingly. If standby time is outside normal working hours, overtime rates will be applicable. Standby time will be added to time actually worked for the computation of overtime

11. WORKING CONDITIONS:

The MAK Controls representative reserves the right to refuse to work under hazardous conditions. In case of doubt, mutual agreement must be reached prior to commencement of any work. All staging and rigging required for access to equipment to be serviced shall be erected by and at the expense of others and shall comply with reasonable safety requirements. The MAK Controls representative shall comply with all plant regulations where applicable. However, any clothing or equipment, except the standard safety hat, safety glasses, safety shoes, and nomex coveralls, shall be provided by Purchaser.

12. LIMITATION OF LIABILITY:

MAK Controls representatives are authorized to act only in a consulting capacity and are not authorized or licensed to operate equipment. All responsibility for operating equipment shall rest with others. Except as provided in Paragraph 14, MAK Controls shall not be liable for loss or damage of any nature.

13. TOOLS AND TEST EQUIPMENT:

The MAK Controls representative will be equipped with instruments, tools and test equipment as required to fulfill service obligations.

14. INSURANCE INDEMNITY:

MAK Controls will at Purchaser's request submit Certificates of Insurance from Sureties chosen by MAK Controls showing the limits of coverage. MAK Controls agrees to indemnify and save harmless Purchaser only against liability imposed on Purchaser by law with respect to bodily injury or property damage to the extent such liability results from the performance of MAK Controls under this contract. MAK Controls does not agree to indemnify and save Purchaser harmless except as set forth herein. Purchaser agrees to indemnify and save harmless MAK Controls for all loss, cost or damage incurred by MAK Controls as a result of Purchaser's or third party's misuse of misapplication of MAK Controls's supplied products. IN NO EVENT, REGARDLESS OF CAUSE, SHALL MAK Controls BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGE EITHER REAL OR ALLEGED.

15. MISCELLANEOUS: