CONTRACT DOCUMENTS

WPCF WASTE UNLOADING STATION

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

June 2023

555 S. Saginaw Street, Suite 201, Flint, MI 48502

COF107601F

SECTION 00 01 10
TABLE OF CONTENTS

33 30 00 - Sanitary Utility Sewerage Piping

33 34 00 - Sanitary Utility Force Mains

DIVISION 34 - TRANSPORTATION

DIVISION 40 - PROCESS INTEGRATION

40 05 07 - Pipe Hangers and Supports

40 05 53 - Process Valves

40 23 00 - Process Piping

40 71 13 - Magnetic Flow Meters

40 72 00 - Level Measurements

40 90 00 - Process Instrumentation, Controls and Monitoring Equipment - General Requirements

40 91 00 - Instrumentation and Controls

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

46 21 83 - Septage Receiving Equipment

END OF SECTION

SECTION 00 11 13
ADVERTISEMENT FOR BIDS

WPCF Waste Unloading Station

Sealed Bids will be received by City of Flint at the Clerk's office, Water Pollution Control Facility, Flint, Michigan, 48532, until 3:00 PM, Local Time, 07-20-2023. After the bid closing time, Bids will be reviewed and publicly read aloud at the City of Flint, Clerk's office.

Bids will be received for the following Work:

> Construction of a new waste unloading station building with septage screen, submersible pump station and interconnecting piping, sitework including bituminous paving and electrical/controls.

Contract Documents may be examined at the following locations:

1. City of Flint, Water Pollution Control Facility, Michigan, 48532
2. Wade Trim, Inc., 555 S. Saginaw Street, Suite 201, Flint, MI 48502
3. Plans and spec are also available for viewing (not to be used for bidding purposes) at no cost online at: www.wadetrim.com/resources/bid-tab/

Each Proposal shall be accompanied by a bid bond, in the amount of at least **five (5)** percent of the amount bid, drawn payable to City of Flint as security for the proper execution of the Agreement.

A mandatory pre-bid conference will be held at 10:00 AM, Local Time, on 07-11-2023 at the Water Pollution Control Facility (G-4652 Beecher Rd., Flint MI 48532). It is a requirement for any prospective General Contractor bidding to attend this mandatory meeting. Representatives of the Owner and the Engineer will be present to discuss the project. Attendance is required for Bidders to be considered responsive.

City of Flint reserves the right to accept or reject any or all bids and to waive any informality in any bids should it consider same to be in its best interest.

Bids may not be withdrawn for the period of 60 days after date of receiving bids.

All inquiries shall be directed to Trevor Wagenmaker, PE - Engineer at Phone: 1-810-620-0069 or email: twagenmaker@wadetrim.com.

SECTION 00 21 13
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.

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

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

D. The term "Owner" means City of Flint, Water Pollution Control Facility, Flint, Michigan, 48532, a Municipal Corporation and being a party of the first part of this Contract.

E. The term “Engineer” means Wade Trim, Inc., 555 S. Saginaw Street, Suite 201, Flint, MI 48502, or a duly authorized representative.

1.02 BIDDERS QUALIFICATIONS

A. No Bid will be considered from any Bidder unless known to be skilled and regularly engaged in work of a character similar to that covered by the Contract Documents. In order to aid the Owner in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by the Owner to do so, shall furnish evidence, satisfactory to the Owner, of the Bidder's experience and familiarity with Work of the character specified, and Bidder's 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. Address and description of the Bidder's plant or permanent place of business.
2. Bidder's performance records for all Work awarded to or started by Bidder within the past three years.
3. An itemized list of the Bidder's equipment available for use on the proposed Contract.
4. Bidder's financial statement, including statement of ownership of equipment necessary to be used in executing Work under Contract.
5. Evidence that the Bidder is authorized to do business in the state in which the project is located, in case of a corporation organized under the laws of any other state; and,
6. Such additional information as will satisfy the Owner that the Bidder is adequately prepared to fulfill the Contract.

1.03 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

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

1. Examine the Contract Documents thoroughly,
2. Visit the site to familiarize himself with local conditions that may in any manner affect cost, progress or performance of the Work,
3. Consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work; and
4. Study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and
5. Promptly notify the Engineer in writing of conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

6. Purchase official Procurement Documents from the 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 the Engineer in preparing the Contract Documents.

1. If such reports are not included as appendices to the Contract Documents, the 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 their Bid each Bidder will, at Bidder's own expense, make such additional investigations and tests as the Bidder may deem necessary to determine Bidder's Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

C. On request, the Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of their 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 the Contractor in performing the Work are identified in Section 01 11 00 - 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 the Owner nor the Engineer will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

1. The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder 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 the Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in Contract Documents and the resolution by the 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.

1.04 PRE-BID CONFERENCE

A. An in-person, mandatory pre-bid conference will be held, and representatives of the Owner and the Engineer will be present to discuss the Project.

B. Bidders are required to attend and participate in the conference to be considered responsive.

C. Engineer will transmit to prospective Bidders a record of such Addenda as the 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.

1.05 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.

1.06 BID SECURITY

A. Bid Security shall be made payable to the 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, the Owner may annul the Notice of Award and the Bid Security of that Bidder will be forfeited.

C. The Bid Security of any Bidder whom the Owner believes to have a reasonable chance of receiving the award may be retained by the 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.

1.07 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 Agreement.

1.08 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.

B. 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 the Contractor if acceptable to the Engineer, application for such acceptance will not be considered by the Engineer until after the Effective Date of Agreement.

C. In addition, in no case shall the Engineer’s denial of the Contractor’s application give rise to any claim for additional cost, it being understood by the Contractor that acceptance of substitute or an “or equal” item of material is at the sole discretion of the Engineer.

1.09 RECEIPT AND FORM OF BID

A. Bids shall be submitted at the time and place indicated in the Advertisement for Bids and shall be accompanied by the Bid Security and other required documents.

1. Bids shall be submitted electronically only as specified herein.

2. Bids shall be 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.

3. 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.

B. Any Bid received after the scheduled time and place indicated in the Advertisement for Bids shall be returned unopened.

C. Owner invites bids on the Proposal and any other form(s) attached thereto.

D. The complete set of Contract Documents must be used in preparing Bids; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

E. The Bid shall include such amounts as the Bidder deems proper for overhead, profit, taxes, General Conditions and such other incidentals as noted in the Contact Documents.

F. The Bidder shall acknowledge of receipt of all Addenda as provided for in the electronic bidding platform. Failure to acknowledge Addenda shall be cause for rejection of bid.

G. The Legal Status of Bidder Form contained in the Contract Documents must be submitted with each Bid 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.

H. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal.

I. A tabulation of the amounts of the base bids and any alternates will be made available after the opening of Bids.

1.10 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.

B. If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with the Owner and promptly thereafter demonstrates to the reasonable satisfaction of the Owner that there was a material and substantial mistake in the preparation of their Bid, that Bidder may withdraw their Bid and the Bid Security will be returned.

1. Thereafter, at the sole option of the Owner, that Bidder will be disqualified from further Bidding on the Work to be provided under the Contract Documents.

1.11 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.

B. 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.

C. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

D. In evaluating Bids, the 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 the Owner's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid Form but the Owner may accept them in any order or combination.

E. Subject to the approval of the 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.

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

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

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

1.12 SIGNING OF AGREEMENT

A. Within fifteen (15) days after the Owner gives a Notice of Award to the successful Bidder, the Contractor shall sign and deliver the specified number of counterparts of the Agreement to the Owner with all other Contract Documents attached.

B. Within ten (10) days thereafter, the Owner will deliver two (2) fully signed counterparts to the Contractor. Engineer will identify, date or correct those portions of the Contract Documents not fully signed, dated or executed by the Owner and the 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 42 43
PROPOSAL

City of Flint - Water Pollution Control Facility, Flint, Michigan 48532

Project: WPCF Waste Unloading Station

BIDDER INFORMATION

Bidder Name: _____

By (Printed Name): _____

Signature: _____

Address: _____

Phone No: _____

Email: _____

The Bidder proposes and agrees, if their Bid is accepted, to enter into an Agreement with the City of Flint 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 the Agreement, and in accordance with the Contract Documents.

In submitting their Bid, Bidder represents, as more fully set forth in the Agreement, that:

1. Bidder has examined copies of all Contract Documents, (consisting of Plans dated Ready for Bidders date and Project Manual dated Ready for Bidders date) which he understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which has been acknowledged.
   A. Addendum _____ Acknowledged by: _____ Date: _____
   B. Addendum _____ Acknowledged by: _____Date: _____
   C. Addendum _____ Acknowledged by: _____ Date: _____
2. 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.
3. Their 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 the Owner.
4. The Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1	WPCF Waste Unloading Station	1	LSUM	$_____	$_____
2	Allowance, MAK Controls				$12,000.00
3	Allowance, Owner-Controlled Change				$150,000.00

Total Contract Price (Items 1 through 3) $_____

5. The Bidder by submitting a Bid, thereby certifies that Bidder or a qualified designated person in Bidder's employ has examined the Contract Documents provided by the Owner for bidding purposes. Further, they certify that Bidder or Bidder's qualified employee has reviewed the Bidder's proposed construction methods and finds them compatible with the conditions which Bidder anticipates from the information provided for Bidding.
6. The Bidder by submitting a Bid agrees to complete the Work under any job circumstances or field conditions present and/or ascertainable prior to bidding. In addition, Bidder agrees to complete the Work under whatever conditions Bidder may create by Bidder's own sequence of construction, construction methods, or other conditions he may create, at no additional cost to the Owner.
7. The Bidder by submitting a Bid, declares that Bidder has familiarized them self with the location of the proposed Work and the conditions under which it must be constructed. Also, Bidder has carefully examined the Plans, the Specifications, and the Contract Documents, which Bidder understands and accepts as sufficient for the purpose, and agrees that Bidder will Contract with the Owner to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.
8. The Bidder will provide a bid bond, in the amount of at least **five (5)** percent of the amount Bid, drawn payable to City of Flint as security for the proper execution of the Agreement.
9. The Bidder by submitting a Bid agrees that 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.
10. The Bidder by submitting a Bid agrees that time is of the essence and, if awarded Contract, that the Work will be Completed on or before the dates/days as specified in the Agreement.
11. Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, shall also apply to the Substantial Completion date.
12. Engineering and inspection costs incurred after the final completion date shall be paid by the Contractor to the Owner as specified in the Conditions of the Contract and Agreement.
13. Proposals may not be withdrawn for a period of 60 days after bid opening.
14. The following documents are made a condition of this Proposal:
    A. Required Bid Security
    B. Legal Status of Bidder
    C. Non-Collusion Affidavit

SECTION 00 43 13
BID BOND FORM

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ as Principal, hereinafter called the Principal, 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 Owner, hereinafter called 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 WPCF Waste Unloading Station.

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 43 45
LEGAL STATUS OF BIDDER

(The Bidder shall check the appropriate box and complete the information requested therein)

☐ A corporation, duly authorized and doing business under the laws of the State of Michigan, for whom _____ whose signature is affixed to this Bid, is duly authorized to execute contracts.

☐ A limited liability company, duly authorized and doing business under the laws of the State of Michigan, for whom _____, whose signature is affixed to this Bid, is duly authorized to execute contracts.

☐ A partnership, all partners with their addresses are:

_____ _____

_____ _____

_____ _____

_____ _____

☐ An individual, whose signature is affixed to this Bid.

_____ _____

SECTION 00 45 13
STATEMENT OF BIDDER'S QUALIFICATIONS

This Proposal is submitted in the name of:

(Print) _____

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

Street: _____ City: _____

State: _____ Zip Code: _____

The undersigned hereby declares their legal status as 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 _____,

☐ CORPORATION INCORPORATED UNDER THE LAWS OF THE STATE OF _____.

The Corporation is:

☐ authorized to conduct business in the State of

☐ not now authorized to conduct business in the State of

☐ 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: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Signed this _____ day of _____, 20_____

By: _____

Printed Name: _____

Title: _____

SECTION 00 45 19
NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State of _____)

) ss:

County of _____)

_____, being first duly sworn, deposes and says that:

1. He/She is the of _____ (Position) of _____(Firm) the Bidder that has submitted the attached Bid;
2. He/She is fully informed with respect to the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham bid;
4. Neither the Bidder nor any of its officers, partners, members, managers, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, entity or person to submit a collusive or sham bid in connection with the Contract Documents for which the attached Bid has been submitted or to refrain from bidding in connection with the Contract Documents or has in any manner, directly or indirectly, sought by agreement, collusion, communication or conference with any other Bidder, entity or person to fix the price or prices in the attached Bid or that of any other Bidder or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against City of Flint, or any person or other entity interested in the proposed Contract Documents; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees or parties having interest, including this affiant.

Name of Bidder: _____

Signed By: _____

Title: _____

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

_____ Notary Public

_____ County, Michigan

Acting in the County of: _____

Notary Seal

My Commission Expires: _____

SECTION 00 51 00
NOTICE OF AWARD

Attention: _____ Date: _____

Project: WPCF Waste Unloading Station

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 _____ Dollars ($_____).

This Project consists of construction of a new waste unloading station building with septage screen, submersible pump station and interconnecting piping, sitework including bituminous paving and electrical/controls, as delineated in your Bid submitted to City of Flint on 07-20-2023.

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

1. Deliver to 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 them.

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 Engineer the required schedules prior to the scheduling of a Pre-Construction Meeting.

Owner: _____

Authorized Signature: _____

Copy to Wade Trim, Inc.

SECTION 00 52 00
AGREEMENT

This Agreement, made and entered into this _____ day of _____ in the year 20___, by and between City of Flint hereinafter called Owner, and _____ hereinafter called Contractor, in consideration of the mutual covenants hereinafter sent forth, agree as follows:

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

Construction of a new waste unloading station building with septage screen, submersible pump station and interconnecting piping, sitework including bituminous paving and electrical/controls.

The Work will be substantially completed within 420 calendar days after the date when the Contract Time commences to run as provided in paragraph 2.03 of Section 00 72 00, and completed and ready for final payment in accordance with paragraph 14.11 of Section 00 72 00 within 450 calendar days after the date when the Contract Time commences to run.

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.

1. 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.
2. The costs of the Engineer incurred after the specified final completion date shall be deducted from the Contractor's progress payments.

Owner and Contractor recognize that time is of the essence of this Agreement and that the Owner will suffer financial loss if the Work is not Substantially Complete within the time specified in paragraph 1.03.A above, plus any extensions thereof allowed in accordance with Article 12 of Section 00 72 00. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by the Owner if the Work is not Substantially Complete on time. Accordingly, instead of requiring any such proof, the Owner and the Contractor agree that as liquidated damages for delay (but not as penalty) the Contractor shall pay the Owner One Thousand Five Hundred Dollars ($1,500.00) for each day that expires after the time specified in paragraph 1.03.A above for Substantial Completion until the Work is Substantially Complete.

1. Liquidated damages charged shall be deducted from the Contractor's progress payment.

Owner shall pay Contractor as provided in the attached Proposal for performance of the Work in accordance with the Contract Documents.

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:

1. The person representing the Contractor who will submit written requests for progress payments shall be: _____
2. The person representing the Owner to whom requests for progress payments are to be submitted shall be: Trevor Wagenmaker, PE - Wade Trim.
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 Section 00 72 00. Applications for Payment will be processed as provided in Section 00 72 00.

In order to induce the Owner to enter into this Agreement, the Contractor makes the following representations:

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.
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.
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 paragraph 1.06.A.2 above as the Contractor 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 the Contractor for such purposes.
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. 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 the Contractor.

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

1. Procurement Requirements (including the Advertisement for Bids, Instructions to Bidders, Proposal, Legal Status of Bidder, and other Documents listed in the Table of Contents thereof).
2. This Agreement
3. Performance and other Bonds
4. Notice of Award
5. Notice to Proceed (if issued)
6. Conditions of the Contract (including Section 00 72 00 - General Conditions and Section 00 73 00 - Supplementary Conditions, if any)
7. Specifications contained within Division 01 through 49 of the Project Manual dated June 2023.
8. Plans consisting of sheets bearing the following general title: WPCF Waste Unloading Station
9. Addenda numbers _____ to _____, inclusive
10. Documentation submitted by the Contractor prior to Notice of Award
11. Any Modification, including Change Orders, duly delivered after execution of Agreement.

Terms used in this Agreement which are defined in Article 1 of Section 00 72 00 shall have the meanings indicated in Section 00 72 00.

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.

Owner and Contractor each binds them self, partners, successors, assigns and legal representatives to the other party hereto, their partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

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 the Owner and the 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 three counterparts. One (1) counterpart(s) each have been delivered to Owner and Contractor, one (1) counterpart(s) 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: City of Flint

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

_____

_____

_____

Contractor: _____

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

_____

_____

_____

License No. _____

Agent for service of process: _____

SECTION 00 55 00
NOTICE TO PROCEED

To: _____ Date: _____, 20_____

_____

Attention: _____

Project: WPCF Waste Unloading Station

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

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

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

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

Owner: _____

Authorized Signature: _____

Copy to Wade Trim, Inc.

SECTION 00 60 00
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 Proposal
3. Construction Change Requisition / Work Change Directive
4. Field Order
5. Non-Compliance Notice / Order to Remove Defective Work
6. Open Items List
7. Punch List Items
8. Request for Final Inspection
9. Request for Information
10. Substitution Request Form
11. Warranty Data Sheet

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 61 12
PERFORMANCE BOND

Bond No. _____

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

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the day of _____, 20_____, 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 _____, 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 of Surety: _____

Telephone: _____

SECTION 00 61 13
LABOR AND MATERIAL PAYMENT BOND

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Owner State, 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 _____, 20_____, for _____

_____

_____

which contract is herein referred to and made 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 _____, 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 of Surety: _____

Telephone: _____

SECTION 00 61 19
MAINTENANCE AND GUARANTEE BOND

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Owner State, 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 _____, 20_____, for _____

_____

_____

Herein referred to and made 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, ContractorC 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 indemnity, 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 _____, 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 of Surety: _____

Telephone: _____

SECTION 00 62 75
ENGINEER'S CERTIFICATE FOR PAYMENT

Job Number: _____ Certificate Number: _____ Date: _____

Owner: _____ Contractor: _____

Project: _____

Contract Date: _____

Substantial Completion: _____ Extended To: _____

Final Completion: _____ 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: _____ 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 Engineer's 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) Contractor is entitled to payment of the Total Balance Due This Certificate.

Certified By: _____ Date: _____

SECTION 00 62 76
CONTRACTOR'S APPLICATION FOR PAYMENT

Job Number: _____ Application No: _____ Date: _____

Owner: _____ Contractor: _____

Project: _____

Contract Date: _____

Period of this Application: _____ to _____

****

Total Earned To Date: _____ Less Total Earned to Due: _____

Previous Certificate: _____ Total Earned this Application: _____

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that to the best of Contractor's 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 Contractor for Work for which previous Certificates for Payment were issued and payments received from Owner, and that current payment shows herein is now due.

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.

By: _____ Title: _____

SECTION 00 62 77
PAYMENT SCHEDULE

Application No.: _____ Date: _____ Period: _____

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

SECTION 00 63 25
SUBSTITUTION REQUEST FORM

Specification Section: _____

Specified Product: _____

Proposed Substitution: _____

Does specified product exceed, in any respect proposed substitution?	___Y	___N
Does substitution affect dimensions shown on Plans?	___Y	___N
Does substitution affect other trades more than original product?	___Y	___N
Does warranty differ from that specified?	___Y	___N
Does substitution affect cost to Owner?	___Y	___N
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: _____

Signature: _____ Date: _____

Position: _____ Company: _____

Address: _____

Telephone: _____ Email: _____

SECTION 00 65 16
CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: WPCF Waste Unloading Station

Owner: City of Flint

Contractor: _____

Contract Date: _____ Project No.: _____

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 _____ which is also the date of commencement of applicable warranties required by the Contract Documents except as stated below. date of Substantial Completion of the Project or portion thereof designated above is hereby established as:

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The date of Substantial Completion of the Work or designated portion thereof, is the date certified by the Engineer when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the Engineer is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. 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 the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance shall be as follows:

_____

_____

_____

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: _____

By: _____

Date: _____

SECTION 00 65 20
SWORN STATEMENT

STATE OF Michigan

COUNTY OF _____}

being duly sworn, deposes and says:

That _____ is the (Contractor) (Subcontractor) for an improvement to the following described real property situated in _____ County, Michigan described as follows:

Insert Legal Description of Property

That the following is a statement of each Subcontractor and Supplier and laborer, for which the payment of wages or fringe benefits and withholdings is due but unpaid, with whom the (Contractor) (Subcontractor) has (contracted) (subcontracted) for performance under the contract with the Owner or lessee thereof, and that the amounts due to the persons as of the date hereof are correctly and fully set forth opposite their names, as follows:

Name of Subcontractor/ Supplier/ Laborer	Type of Improvement Furnished	Total Contract Price	Amount Already Paid	Amount Currently Owing	Balance to Complete (optional)	Amount of Laborer Wages Due but Unpaid	Amount of Laborer Fringe Benefits and Withholdings Due But Unpaid
TOTALS:							

(Some columns are not applicable to all persons listed)

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: Owner or Lessee of the property described herein may not relay on this Sworn Statement to avoid claim of a subcontractor, supplier or laborer who has provided 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.

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 Complied Laws.

_____ day of _____, 20____.

Notary Public: _____

_____ County, Michigan

My Commission Expires: _____

INSTRUCTIONS

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.

An Owner or lessee may withhold payment to a Contractor or Subcontractor who has not provided a Sworn Statement. 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.

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.

If the contract provides for payments by the Owner to the 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 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 Contractor.

SECTION 00 65 21
PREVAILING FEDERAL WAGE RATE - DAVIS BACON ACT

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.

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.

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.

END OF SECTION

"General Decision Number: MI20230075 02/17/2023

Superseded General Decision Number: MI20220075

State: Michigan

Construction Type: Heavy

County: Wayne County in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2023
1	02/03/2023
2	02/17/2023

BOIL0169-003 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 35.95	34.52

CARP0687-008 06/01/2021

	Rates	Fringes
CARPENTER, Includes Form Work	$ 35.16	29.22
PILEDRIVERMAN	$ 34.20	28.82

ELEC0017-003 06/01/2022

	Rates	Fringes
LINE CONSTRUCTION:		
Linemen/Cable Splicer	$ 54.09	7.20+29%

ELEC0058-007 06/28/2022

	Rates	Fringes
ELECTRICIAN	$ 48.52	26.11

ENGI0325-019 09/01/2022

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes

POWER EQUIPMENT OPERATOR

GROUP 1	$ 39.38	24.85
GROUP 2	$ 34.65	24.85
GROUP 3	$ 33.92	24.85
GROUP 4	$ 33.35	24.85

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/ Excavator, Boring Machine, Bulldozer, Crane, Grader/ Blade, Loader, Roller, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non- powered type boom)

GROUP 4: Broom/ Sweeper, Fork Truck, Tractor, Bobcat/ Skid Steer /Skid Loader

---

ENGI0326-008 06/01/2022

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1	$ 46.44	24.95
GROUP 2	$ 44.94	24.95
GROUP 3	$ 43.44	24.95
GROUP 4	$ 43.14	24.95
GROUP 5	$ 42.32	24.95
GROUP 6	$ 41.46	24.95
GROUP 7	$ 40.49	24.95
GROUP 8	$ 38.78	24.95
GROUP 9	$ 30.44	24.95

FOOTNOTES: Tower cranes: to be paid the crane operator rate determined by the combined length of the mast and the boom.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane with boom & jib or leads 400' or longer

GROUP 2: Crane with boom & jib or leads 300' or longer

GROUP 3: Crane with boom & jib or leads 220' or longer

GROUP 4: Crane with boom & jib or leads 140' or longer

GROUP 5: Crane with boom & jib or leads 120' or longer

GROUP 6: Regular crane operator

  GROUP 7: Backhoe/Excavator, Bobcat/Skid Loader, Boring Machine, Broom/Sweeper, Bulldozer, Grader/Blade, Loader, Roller, Scraper, Tractor, Trencher

GROUP 8: Forklift

GROUP 9: Oiler

IRON0025-006 06/01/2022

	Rates	Fringes
IRONWORKER		
Reinforcing	$ 31.43	34.77
Structural	$ 34.50	38.44

LABO0334-009 06/01/2022

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
Landscape Laborer		
GROUP 1	$ 23.82	7.60
GROUP 2	$ 21.60	7.60

LANDSCAPE LABORER CLASSIFICATIONS

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

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

---

* LABO0334-021 09/01/2022

SCOPE OF WORK:
OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General	$ 23.87	16.95
(2) Mason Tender-Cement/Concrete	$ 23.98	16.95
(4) Grade Checker	$ 24.11	16.95
(5) Pipelayer	$ 24.17	16.95
(7) Landscape	$ 16.79	16.80

LABO1191-004 06/01/2022

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
Laborers:		
Common or General; Grade Checker; Mason Tender - Cement/Concrete; Pipelayer	$ 29.75	16.95

PAIN0022-005 07/01/2008

	Rates	Fringes
PAINTER		
Brush & Roller	$ 25.06	14.75
Spray	$ 25.86	14.75

PLAS0067-002 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 30.63	14.07

PLUM0098-005 06/01/2019

	Rates	Fringes
PLUMBER	$ 35.77	35.13

PLUM0636-002 06/05/2017

	Rates	Fringes
PIPEFITTER	$ 40.41	29.35

TEAM0007-006 06/01/2020

	Rates	Fringes
TRUCK DRIVER		
Dump Truck under 8 cu. yds.; Tractor Haul Truck	$ 27.90	.50 + a+b
Dump Truck, 8 cu. yds. and over	$ 28.00	.50 + a+b
Lowboy/Semi-Trailer Truck	$ 28.15	.50 + a+b

FOOTNOTE:
a. $470.70 per week.
b. $68.70 daily.

SUMI2010-073 11/09/2010

	Rates	Fringes
TRUCK DRIVER: Off the Road Truck	$ 20.82	3.69

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 https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor

200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISIO"

SECTION 00 72 00
GENERAL CONDITIONS

ARTICLE 1 DEFINITIONS

1.01 DEFINED TERMS

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

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

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

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

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

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

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

7. Change Order -- A written order to Contractor, reviewed by 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 paragraph 9.04 and paragraph 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 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 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 91 20 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 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 five (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 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, 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, 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 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 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:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto, or
2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or
3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

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

1. reviewing and checking all such information and data,
2. locating all Utilities during construction,
3. coordination of the Work with the owners of such Utilities, and
4. 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. 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, 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 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 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 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.

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

E. 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.

F. 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 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 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).

   e. 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. 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 Section 00 73 00 - 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 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 Section 00 73 00 - 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 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

B. 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.

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

5.11 RECEIPT AND APPLICATION OF INSURANCE PROCEEDS

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

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

parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers.

ARTICLECONTRACTOR'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. Contractor shall not use material in the Work until Shop Drawing or Submittals have been reviewed by 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 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.
4. 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. Contractor shall not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of 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 of other person or organization any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any Subcontractor, Supplier or other person or organization. Owner or Engineer may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, evidence of amounts paid to Contractor on account of specific Work done.

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

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 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 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 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 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 paragraph 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 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, Engineer and Contractor 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, 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 Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

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

C. Contractor shall afford each contractor who is party to such a direct contract, and each utility owner, (and Owner, if Owner is performing the additional work with Owner's employees), proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, Contractor shall do all cutting, fitting and patching of Contractor's Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected.

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

ARTICLE 8 OWNER'S RESPONSIBILITIES

8.01 COMMUNICATION TO CONTRACTOR

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 REPLACEMENT OF ENGINEER

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

8.03 FURNISHING DATA

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

8.04 PAY WHEN DUE

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

8.05 LANDS AND EASEMENTS; REPORTS AND TESTS

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

8.06 CHANGE ORDERS

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

8.07 INSPECTIONS, TESTS, AND APPROVALS

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

8.08 LIMITATION ON OWNER’S RESPONSIBILITY

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

8.09 UNDISCLOSED HAZARDOUS MATERIALS

A. Owner’s responsibility in respect of undisclosed Constituents of Concern uncovered or revealed at the Site is set forth in Paragraph 4.06.

8.10 OWNER’S DESIGNATED REPRESENTATIVE

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

ARTICLE 9 ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

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

9.02 VISITS TO SITE

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

9.03 RESIDENT PROJECT REPRESENTATIVE

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

1. Schedules:

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

2. Conferences:

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

3. Liaison:

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

4. Shop Drawings and Samples:

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

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

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

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

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

6. Modifications:

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

7. Reports:

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

8. Completion:

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

9. Exceptions:

   a. Resident Project Representative:

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

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

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

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

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

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

9.04 CLARIFICATIONS AND INTERPRETATIONS

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

9.05 AUTHORIZED VARIATIONS IN WORK - FIELD ORDER

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

9.06 REJECTING DEFECTIVE WORK

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

9.07 SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS

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

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

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

9.08 DETERMINATIONS FOR UNIT PRICE WORK

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review Engineer's preliminary determinations with Contractor 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 ENGINEERS 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, 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, Contractor's fee shall be 15 percent;

b. for costs incurred under paragraph 12.01.B.3, 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 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;

3) 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

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

3. Engineer's Action: Engineer will review each Change Proposal and, within 30 days after receipt of 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 Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under paragraph 11.01.

4. 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 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 Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving

the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. Mediation:

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

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

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

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

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

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

ARTICLE 12 COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

12.01 COST OF WORK

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

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

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes,

workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

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

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

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

5. Supplemental costs including the following:

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

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

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

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

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

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

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

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

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

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

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

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

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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;

L. 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.

M. 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, 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 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 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 Engineer or Owner. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement shall be required for all Work completed and paid for on previous certificates.

B. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the

Application for Payment shall also be accompanied by such data, satisfactory to Owner, as will establish Owner's title to the material and equipment and protect Owner's interest therein, including applicable insurance. A receipted vendor's invoice showing the quantities of materials and the amounts paid will be required and shall accompany the Application for Payment.

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

14.03 RETAINAGE

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

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

14.04 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

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

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

1. the Work has progressed to the point indicated;
2. the quality of the Work is in accordance with the technical aspects of the Contract Documents subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for any Unit Price Work under paragraph 12.03, and any qualifications stated in the recommendation; and
3. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

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

1. exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work; or
2. involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
3. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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

1. to supervise, direct or control the Work;

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

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

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

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

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

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

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

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

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

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

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

14.05 PAYMENT BECOMES DUE

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

B. Owner may refuse to make payment of the full amount recommended by Engineer because:

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

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

3. 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;

4. Contractor has failed to provide and maintain required bonds or insurance;

5. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

6. 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;

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

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

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

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

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

12. 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;

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

14. 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 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 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. 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 73 00
SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. These Supplementary Conditions amend and supplement Section 00 72 00 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions that are defined and have the meanings assigned to them in Section 00 72 00.

1.02 MODIFICATIONS TO GENERAL CONDITIONS

A. **SGC-1.01 Defined Terms**

1. The definition for “Substantial Completion” in shall be revised as follows:

   Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of the 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 the Engineer’s written recommendation of final payment in accordance with Article 14.11 of Section 00 72 00 - General Conditions. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

B. **SGC-4.02 Subsurface and Physical Conditions; Investigations and Reports**

1. In the preparation of Plans and Specifications, the 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: SME report titled "Geotechnical Evaluation Report, Flint WWTP Septage Receiving Building and Pump Station, Flint, Michigan" dated June 2, 2023.

2. Copies of the following reports and/or tests are attached as Exhibits: **Exhibit 2**

C. **SGC-5.03.D Additional Insured**

1. Add the following language at the end of Article 5.03.A.4 of the Section 00 72 00 - General Conditions:

   Additional named insured on Owner's and Contractor's Protective Policy shall include: Wade Trim, SME and Hubbell, Roth & Clark

D. **SGC-5.04 Limits of Liability**

1. The required limits of liability for insurance coverages requested in Article 5.03 of Section 00 72 00 - General Conditions shall be not less than the following:

   SGC-5.04.A Worker’s Compensation

   Coverage A – Compensation: Statutory

   Coverage B – Employer’s Liability

   Each Accident: $100,000

   Disease – Policy Limit: $100,000

   Disease – Each Employee: $100,000

   SGC-5.04.B Comprehensive General Liability

General Aggregate: $1,000,000

Products – Com/Ops Aggregate: $1,000,000

Personal and Advertising Injury: $500,000

Each Occurrence: $500,000

Fire Damage (any one fire): $50,000

Medical Expense (any one person): $5,000

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury: $500,000

Property Damage: $200,000

or combined single limit: $1,000,000

SGC-5.04.D Owner's Protective - Coverage shall be Occurrence Form

General Aggregate:$1,000,000 $1,000,000

Each Occurrence: $1,000,000

SGC-5.04.E Builder's Risk-Installation Floater

Cost to Replace at Time of Loss

SGC-5.04.F Umbrella or Excess Liability: $2,000,000

E. **SGC- 12.04 Lump Sum Work**

1. Add the following new paragraph after Article 12.03 of Section 00 72 00 - General Conditions, which is to read as follows:

12.04 LUMP SUM WORK

a. When additional work or deletion of work, which is covered by a lump sum item, is required due to a modification, not a normal overrun or underrun in estimated quantities, payment or credit for the work will be based upon apparent unit prices which will be derived by dividing the lump sum price by the estimated plan quantities.

b. Renumber subsequent paragraphs accordingly.

F. **SGC-18 Liquidated Damages**

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

ARTICLE 18 LIQUIDATED DAMAGES

a. If the Contractor shall fail to Substantially Complete the Work within the Contract Time, or extension of time granted by the Owner, then the Contractor will pay to the Owner the amount for liquidated damages as specified in the Agreement for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents. The liquidated damages charged shall be deducted from the 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 the Contractor has given written notice of such delay within seven (7) calendar days to Owner or Engineer.

c. To any preference, priority or allocation order duly issued by the Owner.

d. 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

e. To any delays of subcontractors occasioned by any of the causes specified in Items A and B of this Article.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. This Project includes construction of a new waste unloading station building with septage screen, submersible pump station and interconnecting piping, sitework including bituminous paving and electrical/controls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 50 00 - Temporary Facilities and Controls

1.03 WORK BY OTHERS

A. There is no other work in the Project area, known to the Owner, which would affect this Contract.

1.04 COORDINATION

A. It shall be the responsibility of the Contractor to coordinate his operations and those of his subcontractors in such a manner so as to avoid interference and delays in the areas of common construction activities.

1.05 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 the 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 the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 12 13
WORK SEQUENCE

PART 1 GENERAL

1.01 SUMMARY

A. This section includes a suggested sequence of construction for the Work specified in the Contract Documents. Contractor is not obligated to follow the sequence described herein; Contractor is responsible for means and methods in order to complete the specified Work.

1.02 PROJECT CONSTRAINTS

A. The work of building the new building and pump station can proceed at any time. The existing digester building will remain in operation during the entire project. All existing operations shall continue without interruption. For the excavation work required in the area, access shall be maintained for truck unloadings to the existing digester building connection at all times except for four (4) short driveway shutdowns lasting four (4) hours or less for critical excavation work. For paving work required in the area, this work shall proceed quickly so as not to cause major disruption to truck traffic in the area. Access from one of the two directions into the digester building loading area should be maintained regardless.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 21 00
ALLOWANCES

PART 1 GENERAL

1.01 GENERAL

A. Contractor shall include Allowance(s) listed in the Bid Proposal that 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 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 RELATED REQUIREMENTS

A. The requirements of Section 00 72 00 and all Division 01 sections shall also apply to this work.

1.04 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.

1.05 SUBMITTALS

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

1.06 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.

1.07 SPECIFIC ALLOWANCES

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 PRECONSTRUCTION MEETING

A. Prior to the delivery of materials or the start of any construction, the Contractor shall request a Preconstruction Meeting from the 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 the 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. Engineer
2. Contractor
3. Subcontractor as appropriate to the agenda.
4. Suppliers as appropriate to the agenda.
5. 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 the Owner within seven (7) days of meeting for review at the next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
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 the Engineer for review in accordance with the provisions of Section 00 72 00 - General Conditions.

1.02 PROGRESS SCHEDULES

A. Contractor shall submit one (1) electronic copy in PDF format of Progress Schedules indicating the starting and completion dates of the various stages of the Work and estimated payments to the Engineer.

1. Proposed Progress Schedules shall be submitted to the Engineer prior to the pre-construction meeting.

2. Contractor shall distribute hard copies of the Progress Schedules during the pre-construction meeting for discussion.

3. Progress Schedules shall be updated by the Contractor and submitted electronically (in PDF format) to the Engineer, as a part of applications for progress payments, through completion of the Work. Failure to update Progress Schedule may be the basis for rejection of Applications for Progress Payments.

1.03 SHOP DRAWING SCHEDULE

A. Contractor shall submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to the Engineer.

1. A preliminary Shop Drawing Schedule in accordance with the requirements in Section 00 72 00 shall be submitted by the Contractor prior to the pre-construction meeting.

2. Contractor shall distribute hard copies of the Shop Drawing Schedule during the pre-construction meeting for discussion.

3. A final electronic copy of the Shop Drawing Schedule (in PDF format) shall be submitted by the Contractor at least ten (10) days prior to submitting the first Application for a Payment.

1.04 SCHEDULE OF VALUES

A. Contractor, if applicable, shall submit one (1) electronic copy in PDF format Schedule of Values of the Work to the Engineer.

1. A preliminary Schedule of Values shall be submitted by the Contractorprior to the pre-construction meeting.

2. Contractor shall distribute hard copies of the Schedule of Values during the pre-construction meeting for discussion.

3. A final Schedule of Values (in PDF format), prepared in accordance with the Section 00 72 00 and presented in sufficient detail to serve as the basis for payments during construction, shall be submitted to the Engineer for review at least ten (10) days prior to submitting the first Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

A. Contractor shall submit one (1) electronic copy in PDF format Applications for Payment to the Engineer in accordance with the provisions of Article 14 of Section 00 72 00.

B. Applications for Payment shall be made on forms provided by or approved by the Engineer.

1. Samples of the Contractor's Application for Payment, Payment Schedule and Engineer's Certificate for Payment forms are included in the Contract Documents and can be obtained in digital format from the Engineer.

C. Copies of these forms, with Project specific information completed by the Engineer, will be given to the 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 the Engineer not more often than once per month.

E. Engineer will certify payments with the use of Engineer's Certificate for Payment.

1.06 SHOP DRAWINGS

A. Shop Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to plan sheet number, detail number if applicable, and Specification Section number, and article number.

1.07 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.

1.08 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.

1.09 SUBMISSION REQUIREMENTS

A. Contractor shall make Submittals in accordance with the approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor. No damages will be awarded, or extension of time granted, due to the Shop Drawing and product data review process.

B. Contractor shall submit an entire package of Shop Drawings and Product Data information for major items of Work so that the Engineer can review the package as a unit.

C. Contractor shall submit one (1) electronic copy in PDF format of Shop Drawings and Product Data information containing the following information at a minimum:

1. Field dimensions clearly identified as such.
2. Relation to adjacent or critical features of the Work or materials.
3. Applicable standards, such as ASTM or Federal Specification Numbers.
4. Identification of deviations from Contract Documents.
5. Identification of revisions on resubmittals.
6. Project Title, Date of Submission, Date of Previous Submission, and Specification Section number.

D. Contractor shall initial or sign Shop Drawings and Product Data submittals, certifying the Contractor’s review and approval of Submittal per Section 00 72 00; verification of products, field measurements, field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

E. Engineer shall initial or sign Shop Drawings and Product Data submittal and shall indicate the status of the Submittal, or requirements for resubmittal. Engineer shall return to the Contractor one (1) electronic copy of the Shop Drawing and/or Product Data submittal (in PDF format) for distribution or for resubmission.

1.10 ENGINEER'S REVIEW

A. Upon receipt of any Submittal defined above, the Engineer will:

1. Check each for completeness, clarity, correctness, cohesiveness, legibility, and reproducibility.

2. Review each only for general conformity with the Contract Documents as specified in Section 00 72 00.

B. After review of any Submittal, the Engineer will appropriately affix a stamp, electronic notation box or other means, signifying the Submittal as having received full consideration and review.

C. The "status" of any such Submittal or portion thereof, as appropriate, will be evidenced by any one or more of the following notations clearly signified by a “X” or other similar mark placed in the box adjacent to the notation:

1. Notations for Engineer's Review:

a. No Exceptions Taken

b. Note Markings

c. Comments Attached

d. Rejected

2. Notations for Response Required by Contractor:

a. None

b. Confirm

c. Resubmit

D. Notation Meanings:

1. Elements marked "No Exceptions Taken” indicate that the Contractor may commence with construction, fabrication or purchase of such items.

2. Elements marked "Note Markings" indicate that the Contractor may commence with construction, fabrication or purchase of such items.

a. Proceeds in strict accordance with the Engineer’s notes and/or required corrections/deletions/additions indicated thereon;

b. Pending appropriate response by the Contractor as further noted.

3. Elements marked “Comments Attached” indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by the Contractor as further noted.

4. Elements marked "Rejected" indicate that the Contractor must make the required corrections as shown or noted and resubmit such items to the Engineer for further review.

5. Elements marked “None” indicate that the Submittal requires no further action by the Contractor.

6. Elements marked “Confirm” requires the Contractor to provide affirmation to the Engineer regarding comments, notes, markings, etc. made by the Engineer, and to affirm that the Contractor will comply with the comments, notes, markings, etc.

7. Elements marked “Resubmit” indicate that the Contractor may not commence with construction, fabrication or purchase of such items, and that the Contractor must resubmit items for review that comply with the Contract Documents in the event that those originally submitted do not, or with any comments, notes, markings, etc. made by the Engineer.

1.11 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 the Engineer.

1.12 MANUFACTURER'S OPERATION AND MAINTENANCE DATA

A. Contractor shall submit one (1) electronic copy in PDF format and one (1) bound copy of all operation and maintenance data required per the various Specification sections.

1. Prior to 50% completion of the Project, Contractor shall have submitted one (1) acceptable copy to the Engineer for review.

B. Final copies of the operation and maintenance data shall be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover shall be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents shall be provided in the front of each binder to list the various sections in the manual.

C. The information to be provided in each section of the manual, for each piece of equipment and project component shall include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and subassemblies; installation and operational procedures; complete wiring and piping schematics; lubrication materials and procedures; maintenance procedures; and parts lists complete enough to permit identification of parts by nomenclature, manufacturer’s part number and use.

D. At the front of each section a maintenance schedule shall be provided for each piece of equipment in the section.

1. The schedule shall display the daily, weekly, monthly, semi-annual, annual or fraction thereof, lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimum performance and life of the unit.

2. A common schedule format is to be developed and used for all of the sections. Photocopies or reproductions of the manufacturer's literature will not be accepted.

1.13 AUDIO/VIDEO ROUTE SURVEY

A. When required in Section 00 42 43 - Proposal or Section 01 11 00 - Summary of Work, the Contractor shall furnish the 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, the Contractor shall review with Engineer the Project requirements to ensure that the audio/video is adequate for its intended purpose. Owner shall have the authority to designate areas for which coverage may be added or omitted. The audio/video recording shall be done prior to placement of materials or equipment on the construction area and furnished one (1) week prior to the pre-construction meeting.

C. Format:

1. Audio/Video route survey shall be submitted in the format(s) as specified in Section 01 11 00.

a. Audio/video route survey submission shall be on USB media

b. Format: USB – 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.

D. Complete coverage shall include all surface features located within the public right-of-way, easement areas and adjacent private properties up to building line when such properties lie within the zone of influence of construction and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage shall be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.

E. Houses and buildings shall be identified visually by house number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, location shall be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.

F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall be not less than 12 feet (3.5 m) to ensure proper perspective. The rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates shall be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.

G. Video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information in the upper left hand third of the screen to include the date and time of recording, as well as the corresponding engineering stationing numbers as shown on the Contract Drawings.

1. The date information will contain the month, day, and year. For example, mm/dd/yy, and be placed directly below the time information.

2. The time information shall consist of hours, minutes, and seconds, separated by colons. For example, hh:mm:ss.

H. Engineering stationing numbers must be continuous, accurate and correspond to the Project stationing and must include the standard engineering symbols. For example, Station 14+84.

I. Recording shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than ten (10) percent of the ground area is covered with snow or standing water, unless otherwise authorized by the Owner.

J. In some instances, audio/video coverage may not be suitable for recording necessary details. In such instances, the Owner may specify still photographs to provide coverage. One (1) color photograph shall be provided in accordance with this Section with a suitable description of the photograph's location.

K. Any portion of the Audio/Video Route Survey of insufficient quality as determined by the Engineer shall be redone by the Contractor at no additional cost to the Owner.

L. Each USB shall be properly identified with the Project Title, location, time, and date in a manner acceptable to the Owner.

1.14 PHOTOGRAPHS

A. When required in Section 00 42 43 or Section 01 11 00, the Contractor shall furnish the Engineer with a total of 6 to 10 digital color photographs each month during construction of the

Project, unless some other number and times is specified in Section 01 11 00 - Summary of Work.

B. Photos shall be in digital format (i.e., JPEG, TIFF, GIF, PNG or PDF) and shall have a minimum resolution of 300 dpi.

C. The following information shall be placed on the photo itself or embedded in the digital file:

1. Project Title
2. Contract Number
3. Description of photo's content
4. Date and Time of photo

D. Contractor shall submit photographs monthly along with the Application for Payment as described in Article 14 of Section 00 72 00.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 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. Engineer shall at all times have access to all 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 the Owner. In any case materials may be either inspected or tested when received on the Project.

C. Materials shall not be used until approval has been received from the Engineer. Approval of materials at the producing plant does not constitute a waiver of the Engineer's right for re-examination at the Project site.

D. The 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.

E. The sampling and testing of all materials not specifically mentioned shall be done by generally accepted methods, unless otherwise specified by the Engineer.

1.03 CERTIFICATION OF MATERIALS

A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the standards referred to in the Contract Documents.

1.04 SOURCE QUALITY CONTROL

A. Testing identified in these specifications as Quality Control, which is required to establish quality of materials, equipment or fabricated items, shall be paid for by the Contractor unless otherwise noted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00
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 the Engineer.

B. Contractor shall maintain driveways a minimum of 15 feet (5 meters) 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 at all times provide emergency access to property in the vicinity of the construction for police vehicles, fire equipment, ambulances or other emergency vehicles to protect life, health and property. Areas damaged by emergency vehicles shall be restored by the Contractor at no additional cost to the Owner.

1.03 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.

1.04 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 the 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 the Engineer's field office. Toll charges for calls relating to Project business shall be at the Contractor's expense.

1.05 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 all water consumed during course of the Project at the current rate as set by the agency having jurisdiction.

1.06 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 the OWNER and Engineer. Rules and regulations of the State and local health officials shall be observed, with precautions taken to avoid creating unsanitary conditions.

1.07 POTABLE WATER

A. Contractor shall furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer.

1.08 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 the Owner and Engineer. Contractor shall also furnish a communication system for contacting emergency services. The telephone numbers of the physician, hospital, or emergency services shall be conspicuously posted at the job site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 57 13
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 22 00 - Unit Prices

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 22 00 - Grading

D. Section 31 23 13 - Subgrade Preparation

E. Section 31 23 19 - Dewatering

F. Section 31 23 33 - Trenching and Backfilling

G. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus

B. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

C. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

E. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile

F. ASTM D6241: Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Contractor 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 US std Sieve, maximum; ASTM D4751.
2. Permittivity: 0.05 sec-1, minimum; ASTM D4491/D4491M.
3. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355/D4355M after 500 hours exposure.
4. Tensile Strength: 100 lb - f minimum, in cross-machine direction;124 lb - f minimum in machine direction; ASTM D4632/D4632M.
5. Elongation: 15 to 30%; ASTM D4632/D4632M.
6. Tear Strength: 55 lb - f minimum; ASTM D4533/D4533M.

B. Posts shall be 2 inch cross section hardwood stakes, minimum 3 feet 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 oz per sq yard minimum.
2. Tensile strength of fabric shall be 220 lb - f minimum.
3. Edges of fabric to be reinforced with minimum 5/8 inch diameter polypropylene rope.
4. Ballast chain minimum 5/16 inch galvanized steel.

5. Buoyancy blocks providing buoyancy of 18 lb - f.
6. Length of curtain (water depth) 5 feet.

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 minimum; ASTM D4632/D4632M
2. Elongation: 50 percent minimum; ASTM D4632/D4632M
3. CBR Puncture Strength: 300 lb f; ASTM D6241
4. Trapezoidal Tear: 70 lb - f; ASTM D4533/D4533M
5. Flow Rate: 80 gal/min/sft Minimum; ASTM D4491/D4491M
6. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M
7. Apparent Opening Size: 80 US std Sieve; ASTM D4751
8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.04 EROSION CONTROL BLANKETS

A. Erosion control blankets shall not be used on this project. In lieu of these blankets, the Contractor shall stabilize the seeded areas using straw crimped into the ground using a mulch anchoring tool (disc with vertical coulters) or by hydroseeding with a cellulose or wood fiber mulch.

2.05 BONDED FIBER MATRIX

A. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high-strength, nontoxic adhesive. BFM shall be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous and erosion resistant mat that shall not inhibit the germination and growth of plants. BFM shall retain its form despite re-wetting.

B. Bonded fiber matrix shall consist of:

1. Seed and Fertilizer per Section 32 92 19.
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 per acre of PAM binder and 2500 lbs per acre 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.

B. Tensile Strength:80 lb - f minimum; ASTM D4632/D4632M

C. Elongation: 50 percent minimum; ASTM D4632/D4632M

D. CBR Puncture Strength: 300 lb f minimum; ASTM D6241

E. Trapezoidal Tear: 70 lb - f minimum; ASTM D4533/D4533M

F. Flow Rate: 80 gal/min/sft minimum; ASTM D4491/D4491M

G. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M

H. Apparent Opening Size: 100 US std Sieve maximum; ASTM D4751

I. UV-Stability: 70% retained strength; ASTM D4355/D4355M 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 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 92 19, 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 this Section unless otherwise indicated on the Plans.

C. The resulting coverage must be at least 1/8 inch 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.

3.07 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.

3.08 MAINTENANCE

A. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or Owner to control sediment until final stabilization.

B. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to Owner.

3.09 INSPECTION

A. General:

1. Contractor is responsible to obtain and/or serve as the Certified Operator.

a. 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.

2. 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.

3. 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.

4. Inspector must be certified as a “Storm Water Professional” through the EGLE 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.

1) Situation: waiting for grass to grow, but grass is dormant.

c. Ground is frozen and/or snow covered.

C. Weekly Storm Water Meeting:

1. 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.

2. Contractor shall maintain a log of weekly meetings and document the issues addressed in the meetings on site.

D. Agency Storm Water Inspections:

1. A log of inspections by federal, state, or local storm water or other environmental agencies shall be kept in Contractor’s SWPPP.

2. 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.

3. Any reports issued will be sent to Engineer within 24 hours.

3.10 PROJECT COMPLETION

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

END OF SECTION

SECTION 01 60 00
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 5 feet (1.5 meters) 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, the Contractor shall obtain and distribute copies of such instructions to parties involved in the installation including two (2) copies to the 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, the 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 the Engineer.

1.05 CONTRACTOR'S PRODUCT OPTIONS

A. For products specified only by reference standard, the Contractor shall select any product meeting that standard.

B. For products specified by naming several products or manufacturer's the 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," the Contractor must submit a Substitution Request Form for any product or manufacturer not specifically named, in accordance with Section 00 72 00 - 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 the Engineer, in advance of startup, a schedule and listing of startup and testing procedures for review by the Engineer. Checklists and diagrams may be required to ensure adequate startup and testing. Engineer may recommend changes to the startup procedure as necessary.

D. All 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, the Contractor shall train the 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 the Owner and the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23
CONSTRUCTION LAYOUT

PART 1 GENERAL

1.01 RESPONSIBILITY FOR STAKING

A. Owner will set stakes and markers showing the locations on the surface of various parts of the Work as outlined herein. Additional stakes shall be provided at the expense of the Contractor. Contractor shall furnish such labor and assistance as the Owner may require in setting the same.

B. It shall be the responsibility of the Contractor to transfer surface line and grade to the bottom of any tunnel or to the bottom of any other subsurface operations where ordinary surface line and grade is not feasible.

C. Contractor shall utilize lasers, or surveying instruments run by qualified competent personnel to control the construction installation Work. If the method being used by the Contractor fails to give proper alignment and grade control to the Work, the Owner shall be empowered to order the Contractor to use such other method(s) as will provide adequate control.

D. Engineer may require the Contractor, at the Contractor's expense, to provide such masts, scaffolds, batter-boards, straightedges, templates, or other devices as may be necessary to facilitate laying out, observing and constructing the Work.

E. In the event the Contractor presumes a staking inconsistency, the Contractor shall notify the Engineer immediately to assist in resolving the concern.

1.02 STAKING SCHEDULE

A. Contractor shall submit a completed staking schedule on the form provided by the Engineer showing the order in which the Contractor proposes to conduct the construction operation prior to the preconstruction meeting. The schedule shall be submitted to the Engineer a minimum of three (3) working days prior to the start of construction.

B. During construction, the Contractor shall to the extent possible, limit unnecessary staking requests and coordinate the construction schedule to provide for the efficient and effective use of the survey crew and eliminate excessive survey crew trips to the site.

1.03 LINE AND GRADE

A. Contractor shall request, three (3) working days in advance, from the Engineer additional line and grade stakes as the Contractor may reasonably protect and preserve. Such request by the Contractor shall be on a staking request form.

1.04 RELOCATION AND RE-ESTABLISHMENT

A. Construction Stakes:

1. Where change of location of stakes has been requested by the Contractor, or where the Contractor fails to properly preserve construction survey stakes, such resetting or relocations of stakes shall be done by the Engineer and paid for by the Contractor on the basis of time and materials for such re-staking.

B. Survey Control Points:

1. Contractor shall bear all expense involved in re-establishing and/or resetting any survey control point, land survey point or monument lost or disturbed during his construction operation. Such Work shall be done under the direct supervision of a licensed land surveyor. Such survey control points shall be marked and flagged by the Engineer prior to construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00
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.

1.02 PROJECT RECORD DOCUMENTS

A. Contractor shall deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings and Samples, annotated to show all changes made during the construction process, to Engineer upon completion of the Work. Submittal of the record documents shall be made with a transmittal letter containing:

1. Date
2. Project Title and Number
3. Contractors Name and Address
4. Title and Number of each Record Document
5. Certification that each Document as submitted is complete and accurate

B. Record Documents

1. Shall be a complete set based upon the fully conformed Project Manual. annotations shall include all changes during the execution of the work resulting from Requests of Information, Field Orders, Construction Change Directives, and the as-built conditions which differ from the proposed plans.
2. Underground utilities installed as part of the Project and utilities exposed during execution of the Work shall be surveyed to record their location and elevation. The location shall be based upon available Project data (i.e., coordinate system, benchmarks, etc.).
3. The utility information shall include:
    a. Straight run data every 100-feet.
    b. Bends, valves, fittings, wyes/tees, hydrants, etc.
    c. Crossings of other utilities.
4. The record plans shall be in Portable Document Format (pdf), and full size (22" x 34").
5. Annotations:
    a. dimension changes with strike through and as built dimension.
    b. changes clouded.
    c. sketches, photos, etc. as appropriate.

C. 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 33 00 - Submittal Procedures, shall constitute the basis of such instruction.

1.04 START UP

A. Contractor shall coordinate efforts between Owner, Engineer, any equipment manufacturers, subcontractors and governing agencies in the start up of applicable portions of the Work.

1.05 WARRANTIES

A. Written warranties from the manufacturer shall be provided for major equipment supplied under this Contract. The manufacturer’s warranty period shall be concurrent with the Contractor’s warranty period. The warranty from the manufacturer shall not relieve the Contractor of the one-year warranty starting at the time of Project Substantial Completion. Owner can request written warranties for equipment not classified as major.

1.06 SUBSTANTIAL COMPLETION

A. Certification that the Work is substantially complete shall be in accordance with the General Conditions.

1.07 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 89 00
SITE CONSTRUCTION PERFORMANCE REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes general performance requirements for earthwork complete with, 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 57 13 - Temporary Erosion and Sediment Control

B. Section 31 23 13 - Subgrade Preparation

C. Section 31 23 16 - Structural Excavation and Backfill

D. Section 31 23 19 - Dewatering

E. Section 31 23 33 - Trenching and Backfilling

F. Section 32 12 16 - Bituminous Paving

G. Section 32 13 15 - Sidewalks and Driveways

H. Section 32 92 19 - 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.

2. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Contractor shall comply with Section 01 57 13. Contractor, at Contractor's 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 theNational 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 the Engineer.

1. 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.

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 the Engineer.

1.06 PROTECTION OF PLANT LIFE

A. All trees, shrubs, and other types of vegetation not within the limits of the Work or not designated on the Plans or by the 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 the Contractor's operation shall be repaired or replaced by the Contractor, at Contractor'is expense, as determined by the 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 the Contractor's operations shall be repaired or replaced by the Contractor, to the satisfaction of the owner, at Contractor's expense.

C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by the 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 MDOT Section 902.

PART 3 EXECUTION

3.01 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. The costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at the Contractor's expense.

C. Refer to Section 31 23 19 for additional requirements.

3.02 GENERAL

A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If the Contractor requires additional area, the 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.

3.03 EXISTING IMPROVEMENTS

A. Contractor shall expose existing sewers and structures to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the 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 811 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, the Contractor, at Contractor's expense, shall perform construction 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, the Contractor shall make all arrangements with the owner of the utility for the moving. Costs incurred for such moving shall be at the Contractor's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, the Contractor shall furnish the 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, the Contractor shall provide the 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 the 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. The new material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. The bedding and backfill material, unless otherwise specified, shall be an approved Class II granular material, compacted to 95% 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. The relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at the 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.

B. Neither the correctness nor completeness of such information is guaranteed or implied.

C. Structures shall be protected, preserved or restored by the 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 the Contractor, at Contractor's expense, to protect the structures.

B. When it becomes necessary for the Contractor to move one of these buildings or structures in order to proceed with construction, the Contractor, at Contractor's 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, the Contractor shall furnish the 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, the Contractor, at Contractor's 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, the Contractor shall install a masonry bulkhead in the structure.

C. Removal of a culvert or sewer also includes the removal and disposal of any end treatments or headwalls.

3.10 REMOVAL OF STRUCTURES

A. The 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 95% 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 the Engineer, shall be installed and maintained by the Contractor, during the rebuilding period.

3.11 ABANDONING STRUCTURES

A. The structure shall be broken down to at least 30 inches below the subgrade.

B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by the Engineer.

C. The structure shall be backfilled with flowable fill to 12 inches 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 12 inches below finished grade.

D. The remainder of the excavation shall be backfilled with a granular material, compacted to 95% of its unit weight, and shall meet with the approval of the Engineer. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 REMOVING PAVEMENT

A. The 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. The pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.

C. The cutting shall be accomplished by using a power-driven concrete saw approved by the Engineer. The depth of the saw cut shall be a minimum of 6 inches, to insure 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 5 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 the Engineer along a line parallel to and at least 12 inches 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.

G. Removal of Curb for Curb Drop:

1. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling, approved by the Engineer, so as to leave a neat surface with a maximum 1 inch lip, without damage to the underlying pavement.

H. Removal of Curb and Gutter:

1. 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 the 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.

I. 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 the Contractor's expense.

J. Any 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 the Engineer, at the Contractor's expense.

3.13 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. The material shall be placed by the controlled density method or other effective means having the approval of the Engineer and shall be compacted to 95% of maximum unit weight.

B. The furnishing, placing and compacting of the backfill material shall be at the Contractor's expense.

3.14 RESTORATION IN RIGHT-OF-WAY AND YARD AREAS

A. The 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. The disturbed areas may be shaped by "Machine Grading" or another method approved by the 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 the Contractor at Contractor's expense.

C. Disturbed areas shall be graded to receive either topsoil and seed or topsoil and sod. The topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19 or 32 92 23.

D. Contractor, at Contractor's expense, shall furnish, place, and compact any additional fill, meeting the approval of the Engineer, needed to restore the disturbed areas to the cross sections called for on the Plans or as determined by the Engineer.

3.15 RESTORATION OF AGGREGATE SURFACES

A. Shoulders:

1. The 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. The 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" of Section 31 23 33. 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 Contractor's 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. The 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. Any aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by the Engineer, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at the Contractor's expense.

   a. The upper three 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 22A or 23A compacted aggregate, with calcium chloride applied at the rate of of aggregate.

4. Contractor, at Contractor's expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.

C. Compaction

1. Compaction of aggregate shall be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.16 RESTORATION OF PAVED SURFACES

A. Contractor shall furnish and 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. The 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" of Section 31 23 33.

2. Unless otherwise specified on the Plans or as determined by the Engineer, the concrete removed shall be replaced with 3500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.

3. The construction of concrete pavements shall be in accordance with Section 32 13 13.

4. 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 the state of Michigan and to Section 32 13 15, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.

D. Bituminous

1. The 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" of Section 31 23 33.

2. Bituminous pavement or bituminous surface course with an aggregate base shall be replaced in accordance with Section 32 12 16.

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 the Engineer, shall include complete replacement full width and length (extending a minimum of 25 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 12 16.

3.17 SOIL EROSION AND SEDIMENTATION CONTROL

A. Contractor shall comply with the requirements of Section 01 57 13. Prior to commencing any type of earthwork, the Contractor shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.

B. Contractor 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 the 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.

3.18 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 the Owner, shall transport all excess excavation to a site(s) designated by the Owner.

1. The excess excavation shall be graded by the 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 ±3 inches.

C. When the excess excavation has not been requested by the Owner, the Contractor shall remove and properly dispose of the material at no additional cost to the 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 the 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

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work of this section includes, but is not limited to, demolition of and disposal of building materials, concrete and included reinforcement, brick or tile masonry, wood and metal framing, mechanical and electrical components, plumbing components, structural elements and appurtenances from structures and facilities as listed in this Section and/or identified on the Drawings which are required to be removed as necessary where encountered within the limits of excavation or as directed by the Owner:

1. Demolish building, walkway, drive, steps, fencing and associated structures.
2. Demolish all miscellaneous items as shown on the Drawings.

B. Contractor shall coordinate with the agencies having jurisdiction with regard to requirements and permits.

C. Notify Owner and adjacent neighbors of the date and time of the demolition at least 24 hours prior to commencing work.

D. Contractor shall have competent Superintendent on site at all times when demolition work is taking place.

E. Perform demolition work hours Monday through Friday between 7:00 AM and 6:00 PM. The Contractor may not start a demolition that cannot be completed in one day on a Friday. The Contractor may not leave a partially demolished site unattended over the weekend.

F. Secure all necessary permits including, but not limited to, Building Permit to Demolish, Sewer Permit, and Hydrant Permit. If necessary, applicable sidewalk repair permit shall be secured. All permits are the Contractor’s responsibility unless otherwise noted.

G. Coordinate work performed to have utilities shut off for project location. Ensure there is no loss of utilities to surrounding properties.

H. Notify MISS DIG prior to beginning work.

I. Prior to demolition, walk through interior of structure to verify it is unoccupied and to confirm that all utilities have been properly disconnected.

J. Take all necessary precautions to protect workers and the public, including but not limited to, warning signs, barricades, and fall protection. Eliminate unnecessary hazards before leaving the jobsite at the end of each day. Hazards such as missing sidewalks and demolition debris must be enclosed with yellow caution tape.

K. Reinstall fall protection and safety precautions at the end of each workday.

L. In the event of accidental damage to an adjacent property, speak with the property owner and notify Owner immediately. Contractor is liable for damage to neighboring property.

M. Provide to Owner prior to, and as an additional condition of, payment for work performed, all pertinent verified original receipts from an approved land fill or dump site, evidencing that all waste material from the job site contracted herein was disposed of in a proper manner. Receipts shall bear the date, job address, location of land fill or dumpsite, cubic yardage dumped, and bear the signature of the Contractor’s driver and receiving facility representative. In the event such land fill receipts are not provided, payment shall be withheld until it is received and approved thereof.

N. Minimize noise, dust and inconvenience to neighbors. Contractor will provide labor and use hoses of sufficient length (minimum 100 lineal feet) to prevent the discharge of visible dust emissions to the outside air throughout demolition.

O. Restore property as required herein and as shown on the Drawings.

P. Property dimensions and quantities must be field verified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 31 23 16 - Structural Excavation and Backfill

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; Current Edition

B. NFPA 241 - Standards for Safeguarding Construction, Alteration, and Demolition Operations; 2013 Edition

1.04 QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor shall adhere to and disposal of all demolition materials in accordance with the requirements of all applicable ordinances, codes, statutory rules and regulations of federal, state and local authorities.

B. Protect persons and property throughout progress of work. Proceed in such manner as to minimize spread of dust and flying particles and to provide safe working conditions for personnel. Contractor shall take any necessary precautions to capture all particles and construction debris within the site limits.

C. Maintain circulation of traffic within area at all times during demolition operations.

D. Obtain permission from the Owner before abandoning or removing any existing structures, materials, equipment and appurtenances.

E. Make necessary arrangements with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.

1.05 SUBMITTALS

A. Demolition Plan:

1. Submit to the Owner for review, a Demolition Plan describing proposed sequence, methods, and equipment for demolition and disposal of each structure.

2. Pre-Demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by building demolition operations.

3. Methods of demolition and equipment proposed to demolish each structure.

4. Copies of any authorizations and permits to perform work.

5. Submit documentation confirming acceptance by landfill(s) or other disposal facilities of demolition materials.

6. Accurately record actual locations of capped and active utilities and subsurface construction.

7. Statement of Refrigerant Recovery signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DEMOLITION - GENERAL

A. Wet down work during demolition operations to prevent dust from arising.

B. For structures identified for demolition on the drawings, the Contractor shall completely remove the foundation below ground surface as well as basement walls in their entirety, and fill to level of adjacent ground with suitable material and compact in a manner that complies with requirements stated elsewhere in the Specifications, particularly Section 31 23 16 - Structural Excavation and Backfill.

C. 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.

D. 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 unless shown otherwise.

5. All 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. All 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. Patch existing floor smooth with non-shrink grout or suitable epoxy finish for sure

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. All 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, to allow for relocation where shown and to maintain the integrity of the grounding systems.

10. Conduits and wires shall be abandoned or removed where shown. All 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. The conduits shall be suitable 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.

E. 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.

F. 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 the 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 the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the 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 shall be neatly repaired so as to leave only finished edges and surface exposed.

3.02 BACKFILLING

A. Do not use demolition debris as backfill material.

B. Below-Grade Areas: Completely fill below grade areas and voids resulting from building demolition operations with granular backfill according to backfill requirements in Section 31 23 16 - Structural Excavation and Backfill.

C. Backfill demolished areas to existing ground level or foundation level of new construction as specified elsewhere in the Contract Documents.

3.03 DISPOSAL

A. Contractor shall dispose of reinforced concrete, masonry, contained steel or castings and other materials which are removed at an approved offsite location.

B. Dispose of debris and other non-salvaged materials offsite in licensed landfills that are deemed appropriate for the types of debris to be disposed.

C. Materials, equipment, and appurtenances removed, that are not designated for relocation, become property of Contractor. Haul from site and dispose of according to local, state and federal regulations.

3.04 RESTORATION

A. Restore surface of areas affected by building demolition to match adjacent conditions or meet local codes, whichever is more stringent.

END OF SECTION

SECTION 02 41 13
SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish labor, materials and equipment necessary for the removal and subsequent disposal of the area(s) slated for demolition, including but not limited to supports, piping, electrical equipment, mechanical equipment, floors, walls, ceilings, doors, windows, wood or metal framing, masonry, and asphalt paving, as shown on the Contract Drawings and specified herein. In addition, various utilities shall be cut, abandoned and capped, or completely removed; miscellaneous clearing and grubbing of trees, brush, and vegetation at boundary area shall be performed.

1. Work includes the removal and disposal of the building materials and debris including the removal and disposal of miscellaneous site debris, including but not limited to building area debris, woods, piping materials, bricks, roof materials, metal equipment and all other non-specified material and debris found at the site.

2. Work includes the removal and disposal of the building debris and concrete materials generated by the demolition of the structures listed above. Removal and disposal of concrete, rebar, and steel is incidental to the project. It is recommended that steel be recycled. Contractor may recycle concrete and asphalt to reduce cost.

B. Contractor has salvage rights to all salvageable restaurant equipment, electrical equipment, metals, salable items, and other recyclable materials unless indicated otherwise.

1. Contaminated building materials shall not be salvaged and shall be disposed of in accordance with applicable local, state, and federal regulations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 31 19 - Project Meetings

C. Section 31 23 16 - Structural Excavation and Backfill

1.03 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner’s property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner’s property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to the Owner’s designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Owner, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.04 PERMITS

A. Permits described here cover the general description of the permits called for demolition. The permits described below are not necessarily all of the permits required for completion of this project.

1. Demolition Permit: Contractor shall be responsible for obtaining a demolition permit from the Building Department. Contractor is responsible for all permit fees.

2. NESHAP Notification of Intent to Demolish: Contractor shall be responsible for filing and for the fee involved with submitting an intent to demolish permit from the Michigan Department of Environment, Great Lakes and Energy, Air Quality Division.

    a. The notification shall describe the demolition tasks to be conducted and the quantities of asbestos containing materials specified for abatement.

3. Soil Erosion and Sedimentation Control: Contractor shall be responsible for filing and for the fee involved with obtaining soil erosion and sedimentation control permits from the agency having jurisdiction.

1.05 MATERIAL OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner’s property, demolished materials shall become the Contractor’s property and shall be removed from the site with further disposition legally at Contractor’s option.

1.06 SUBMITTALS

A. Submit each of the following items in accordance with Section 01 33 00:

1. Work Plan: Prior to proceeding with the demolition, removal and disposal work, the Contractor shall submit a work plan which includes the means, methods and procedures proposed for the accomplishment of the removal and disposal work.

    a. Means, methods and procedures shall provide for safe conduct of the work; careful removal and disposition of buildings and structures, and solid materials and wastes; and protection of property that is to remain undisturbed.

    b. Procedures shall provide a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

    c. The name and location of disposal facilities for all removed materials shall be submitted in the Work Plan.

    d. Work plan shall be based on work experience, and the guidance provided in this specification. The cost of work plan preparation is incidental to the project.

2. Demolition Schedule: Contractor shall submit a complete coordination schedule for demolition work, including shut-off and continuation of utility services, with the Engineer's approval prior to start of the work.

    a. Schedule shall indicate proposed methods and operations of facility demolition and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.

3. Disposal Documents: Contractor shall provide copies of all licenses, certifications, permits, agreements, manifests, chain of custody records, weigh tickets, meter recordings, delivery tickets, and receipts required or issued for the disposal of materials, the methods used, and the disposal areas and facilities. Contractor shall also provide a copy of the results of tests performed to comply with the requirements of each disposal facility.

4. Manifests: Contractor shall submit a copy of the official manifest for each shipment of removed materials including, but not limited to, building and structure debris, concrete and brick debris, and miscellaneous site debris and solid wastes evidencing delivery of the material to an approved licensed disposal facility. All manifests shall be in accordance with the requirements of all the applicable federal, state and local regulations. Manifests shall be signed by the Owner or the Owner's Representative.

5. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions in accordance with Section 01 77 00.

1.07 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing Environmental Protection Agency notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-Demolition Conference: Conduct conference at Project site to comply with Section 01 31 19.

1.08 PROJECT/SITE CONDITIONS

A. Condition of Facilities: Owner assumes no responsibility for actual condition of facilities to be demolished. Contractor shall visit the site and inspect the existing facilities.

B. Occupancy: Owner may continuously occupy areas of site immediately adjacent to areas of selective demolition. Conduct demolition work in manner that will minimize need for disruption of the Owner's normal operations.

C. Protections: Provide temporary barricades and other forms of protection to protect the public from injury due to selective demolition work.

1. Provide protective measures as required to provide free and safe passage of the Owner, tenants, vehicles, and general public to areas directly affected by demolition activities and those adjacent to such activities.

2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

4. Protect floors with suitable coverings when necessary.

5. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing structures.

6. Provide temporary dust and debris barriers of fire resistant materials to control dust and debris and to confine demolition of existing and finished work.

7. Remove protections at completion of work.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

E. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without approval from the Owner and providing alternate routes around closed or obstructed traffic ways.

F. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

G. Explosives: Use of explosives is not permitted.

H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. General:

a. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing utilities or schedule work to install interrupted utilities first, as acceptable to the Owner.

b. Maintain fire protection services during selective demolition operations.

c. Provide temporary support and protection of existing utilities, which cross the proposed piping trench.

d. Permits shall be obtained from utility or agency having jurisdiction, if necessary. Contractor is responsible for all permit fees.

e. If relocation of any utility is necessary, the Contractor shall be responsible for associated fees or expenses, unless indicated otherwise.

2. Electrical Disconnection: Contractor shall verify that on site electrical wiring entering all structures to be demolished or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or de-energized prior to proceeding with demolition operations.

a. Contractor shall coordinate with the local electrical utility company for any necessary relocation of utilities and be responsible for any associated fees or expenses.

3. Water Disconnection: Contractor shall perform or verify that on-site water lines entering all structures or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.

4. Sewer Disconnection: Contractor shall locate and bulkhead all sewer connections from the building structure prior to proceeding to demolition. The work shall be performed as indicated on Site Plans in accordance with .

5. Gas Disconnection: Contractor shall verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.

6. Telephone and Cable Disconnection: Contractor shall verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.

I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

J. Provide ventilation to maintain non-toxic unpolluted working area for adjacent the Owner's operating areas and construction/demolition areas. Welding and cutting torches producing smoke or toxic fumes must be adequately ventilated.

1.09 WARRANTY

A. 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

2.01 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Contractor shall use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Provide written pre-demolition report to the Engineer prior to start of Work. The report shall contain the following information:

1. Determination of condition of framing, floors, and walls, and possibility of unplanned collapse of any portion of structure or adjacent structure where employees may be exposed.

2. Various phases of demolition and description of how employees will be protected from unplanned contact with active utilities, exposure to toxic materials and gases, falling objects, structural collapse, and any other hazards routinely associated with demolition activities.

B. Locate existing utilities within project limits prior to any demolition. Verify that utilities have been disconnected and capped.

1. If unanticipated mechanical, electrical or structural elements that conflict with intended function or design are encountered, investigate and measure nature and extent of conflict and promptly submit a written report to the Engineer.

a. Pending review of the report by the Engineer, the Contractor shall rearrange the selective demolition schedule, and notify the Engineer and the Owner as necessary to continue overall job progress without delay.

3.02 PREPARATION

A. Conduct demolition operations and remove debris in manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities designated to remain.

1. Provide temporary barricades and other forms of protection as required for safety and security.

2. Provide barriers and appropriate to restrict pedestrians from wandering into construction areas.

3. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure no water leakage or damage occurs to structure or interior areas.

C. Erect and maintain dust-proof partitions and temporary enclosures to limit dust or dust migration, and to separate areas from fumes and noise, if necessary.

D. Provide and maintain interior and exterior shoring, bracing or structural support to preserve stability and prevent movement, settlement, or collapse of structures and adjacent facilities that are not part of demolition.

E. Provide acceptable temporary security barriers where physical security of buildings or fences is compromised due to demolition work.

3.03 SALVAGE REQUIREMENTS

A. Coordinate with the Owner to identify structure and/or building components and equipment required to be removed and delivered to the Owner subsequent to demolition.

1. Owner shall tag components and equipment designated for salvage.

B. Contractor shall protect designated salvage items from demolition operations until items can be removed.

1. Carefully remove components and equipment indicated to be salvaged.
2. Disassemble as required to permit removal .
3. Package small and loose parts to avoid loss.
4. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
5. Deliver salvaged items to the Owner and obtain signed receipt from the Owner indicating that the Owner has received tagged items.

3.04 REPAIRS

A. Contractor shall provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces whether shown or not shown, with materials and procedures approved by the Engineer.

B. Return structures and surfaces not part of demolition, to conditions existing prior to commencement of demolition work.

C. Contractor shall repair all damages caused to adjacent facilities by demolition as directed by the Engineer at no cost to the Owner.

D. Contractor shall make a detailed inspection after patching and repairing has been completed and shall carefully remove splattering of mortar from adjoining work (particularly, but not limited to, plumbing fixtures, trim, tile, and finish metal surfaces), and make good any damage caused by such cleaning operations.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

A. Contractor shall remove and legally dispose of demolished materials, site debris, rubbish, and other materials resulting from demolition operations shall be promptly removed.

1. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the Owner.
2. If the Contractor encounters material during removal that is suspected to be potential hazard, stop work immediately and notify the Engineer.
3. Disposal shall conform to Federal, State and local requirements.
4. Removed materials shall be documented by manifests and disposal facility tickets with copies given to the Engineer 48 hours after removal from the site.

B. Burning of removed materials from demolished structures shall not be permitted on site.

3.06 RECYCLING

A. Owner encourages the recycling of demolition debris where appropriate. Contractor has the option to recycle any material found or demolished on site in order to reduce costs or project duration.

B. Although the materials are not limited, it is recommended that at least steel and concrete be recycled.

1. Steel and concrete to be recycled can be stockpiled on site and eventually removed. Steel separated from demolition rubble may be recycled and becomes the property of the Contractor.
2. Contractor will not be allowed to abate on site any lead paint found on the steel unless appropriate procedures and federal, state and local codes or regulations are followed.
3. Any material stockpiled for recycling shall be removed from the site prior to the contract end date and/or site restoration.

3.07 CLEANING

A. During and upon completion of work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition in Division 1.

B. Contractor shall clean adjacent structures and facilities of dust, dirt, and debris caused by demolition, as directed by the Engineer or Owner, and return adjacent areas to condition existing prior to start of work.

END OF SECTION

SECTION 03 01 30
CONCRETE REPAIR AND REHABILITATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Section Includes: Furnishing of materials, labor, tools, and equipment necessary to repair, patch, and restore poorly placed or deteriorated concrete; and repair of joints and reinforcing steel. This includes removal of deteriorated concrete, surface preparation and installation of repair materials at deteriorated areas, cracks, and joints in concrete floors, walls, and ceilings as indicated on the drawings and specified herein.

B. Defects that require repair include tie holes, exposed steel, voids, holes, honeycombed areas, spalling, delamination, cracking, and other defects as determined by the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 03 11 00 - Concrete Forming

C. Section 03 20 00 - Concrete Reinforcing

D. Section 03 30 00 - Cast-in-Place Concrete

E. Section 03 32 00 - Construction and Expansion Joints

F. Section 03 60 00 - Grouting

1.03 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 201.1R-08 Guide for Making a Condition Survey of Concrete in Service
2. ACI 546R Guide to Concrete Repair

B. American Society for Testing and Materials (ASTM)

1. ASTM C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars.
2. ASTM C157/C157M Test Method for Length Change of Hardened Cement Mortar and Concrete.
3. ASTM C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing
4. ASTM C882/C882M Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
5. ASTM D412 Test Methods for Vulcanized and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
6. ASTM D624 Test Methods for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
7. ASTM D903 Test Methods for Peal or Stripping Strength of Adhesive Bonds.
8. ASTM D3359 Standard Test Methods for Measuring Adhesion by Tape Test.

C. The Society for Protective Coatings (SSPC)

1. SSPC-SP 13 Surface Preparation of Concrete

1.04 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00.

B. Submit manufacturer's data completely describing concrete repair materials for each type of product to be utilized in the concrete repair process. Include material descriptions; chemical composition, physical properties, test data, and mixing, preparation, and application instructions. Submittals shall include a written statement from the Contractor that all products are compatible with each other, and consistent with the warranty requirements of the project.

C. Concrete Rehabilitation Qualifications:

1. Submit the name and experience record of the concrete rehabilitation Contractor. Include a list of at least 5 of the Contractor's previous utility or industrial installations rehabilitated, and identify the responsible officials, architects and engineers concerned with the project, contact information, and approximate contract price.

D. Rehabilitation program: For each phase of the rehabilitation process, including protection of surrounding materials and site during operations, describe in detail the materials, methods, equipment and sequence of operations to be used for each phase of the work.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer of the specified product shall have been in existence, for a minimum of 10 years.

B. Installer Qualifications: Work must be performed by a firm having not less than 5 years successful experience in comparable concrete repair and rehabilitation projects and employing personnel skilled in the restoration process and operations indicated.

C. Source limitations: Obtain concrete patching and rebuilding materials, crack injection materials, corrosion inhibitors, sealants, all through one source from a single manufacturer.

D. Construction Tolerances: Construction tolerances shall be as specified in Section 03 30 00, except as modified herein and elsewhere in the Contract Documents.

E. Mockups: Install mockups for each type of concrete removal and patching, concrete repair, crack injection, and joint sealing to demonstrate the quality of materials and execution for approval by the Owner.

1. Approved mockups may become part of the completed work if undisturbed at time of substantial completion.

2. The independent testing agency, or other inspection party representing the Owner, shall be present during the construction of the mockups.

3. Quality Control testing, as required by this Specification, shall be performed on each mockup.

F. Pre-installation conference: Prior to beginning any concrete repair or rehabilitation work, the Contractor shall meet with the Owner to thoroughly discuss the proposed work, techniques and schedule. Representatives of the Manufacturer and Installer of repair and rehabilitation materials, as well as the independent testing agency, shall attend the pre-installation conference.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

B. Store and condition the specified product as recommended by the Manufacturer.

C. Store in a suitable location approved by the Owner at all times. Keep area clean and accessible. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.

D. Handle materials carefully to prevent inclusion of foreign materials.

E. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

1.07 PROJECT/SITE CONDITIONS

A. Existing Conditions:

1. Hot Weather: ACI 305
2. Cold Weather: ACI 306
3. Do not place concrete repair mortar during precipitation, unless adequate protection is provided.
4. Coordinate coatings application with other trades to assure adequate illumination, ventilation, and dust-free environment during application and curing of coatings.
5. Maintain a safe work environment in accordance with Federal, State, Local and project site regulations and guidelines.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementitious, non-sag mortar, specifically formulated for the repair of surface defects.

B. Provide the mortar with a penetrating corrosion inhibitor.

C. Repair mortar shall have the following properties:

Physical property	Value	ASTM Standard
Compressive strength (min) at 1 day at 7 days at 28 days	 3000 psig 6000 psig 7000 psig	C109
Bond strength (min) at 28 days	2200 psig	C882 (modified)
Freeze/Thaw resistance (min) 300 cycles	98 percent	C666

D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.

E. Repair Mortar Manufacturer, or Equal

1. Sika Corporation, SikaTop 123 Plus

2.02 NON-SHRINK GROUT

A. Provide non-shrink grout conforming to the requirements of Section 03 60 00.

2.03 CONCRETE MATERIALS CEMENT

A. Cement:

1. Use Type II Portland cement unless otherwise indicated.

B. Repair Concrete:

1. Where required, provide repair concrete composed of structural concrete with maximum one- inch coarse aggregate meeting the requirements of Section 03 30 00.
2. Provide a minimum repair thickness of 3 inches.

C. Cement Grout:

1. Provide cement grout that meets the requirements of Section 03 60 00.

2. Provide a minimum repair thickness of one inch.

D. Miscellaneous Materials:

1. For concrete construction materials not covered specifically in this Section, conform to the requirements of Section 03 30 00.

2.04 AGGREGATE

A. Obtain the permission of the manufacturer and Owner before using aggregate to extend repair mortar and non-shrink grout products.

B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in Section 03 30 00.

2.05 BONDING AGENT AND ANTI-CORROSION COATING

A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.

2.06 BONDING AGENT MANUFACTURER, OR EQUAL

1. Sika Corporation, Armatec 110 EpoCem.

2.07 EPOXY GROUT

A. Provide an epoxy grout conforming to the requirements of Section 03 60 00.

2.08 EPOXY RESIN

A. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.

B. Provide a minimum bond strength of 2900 psig when tested per ASTM C882 at 14 days, moist cured.

C. Epoxy Resin Manufacturer, or approved equal:

1. Sika Corporation, Sikadur 35, Hi-Mod LV

2.09 PROTECTIVE COATING

A. Waterproofing:

1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.

2. The waterproofing shall be certified as being in conformance with NSF 61.

3. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.

4. Waterproofing Manufacturer, or Equal

a. Sika Corporation, Sika Top Seal 107.

2.10 FORMWORK

A. Where needed, provide formwork that meets the requirements of Section 03 11 00.

2.11 REINFORCEMENT STEEL

A. Where required, provide reinforcing steel that meets the requirements of Section 03 20 00.

2.12 POLYURETHANE SEALANT

A. Provide a 2-part polyurethane, gun-grade sealant, certified as being in conformance with NSF 61.

B. Polyurethane Sealant Manufacturer, or approved equal:

1. Sika Corporation, Sikaflex – 2C

2.13 POLYURETHANE CHEMICAL GROUT

A. Use polyurethane chemical grout for non-structural crack repair

B. Polyurethane Chemical Grout Manufacturer, or approved equal:

1. Sika Corporation, SikaFix HH

2.14 HYDROPHILIC WATERSTOP

A. Provide hydrophilic waterstop conforming to the requirements of Section 03 32 00.

PART 3 EXECUTION

3.01 GENERAL

A. Repairs:

1. Repair defects immediately after form removal.
2. Repair techniques will be reviewed during the pre-construction meeting between the Contractor and Owner.
3. The Contractor shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each particular repair.
4. Choose repair materials to match the adjacent concrete surface in color and texture.
5. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.
6. Protect adjacent portions of the structure, including all pipes, and mechanical equipment, from debris generated by repair activities.
7. For portions of the structure that are not identified to be repaired, maintain in their original condition.
8. Dampen area to be patched and area at least 6 inches wide surrounding area to be patched for at least 24 hours to prevent absorption of water from patching mortar.

B. Structural Stability:

1. Use caution not to weaken the structural capacity of a beam, wall, slab, or other concrete member during concrete removal.
2. For severely deteriorated concrete members, consult with the Owner before removing a major portion of any structural member.
3. Shoring may be required in order to support the structure and to protect workers.

C. Shoring:

1. Contractor shall design the shoring to adequately distribute the load to the foundation in such a manner as to avoid damage to the structure.
2. Maintain the shoring in place until all repairs are completed and structurally repaired areas have achieved their full 28-day design strengths.

D. Provide off-site disposal of debris generated as a result of repair procedures.

E. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of Section 03 30 00.

3.02 SUGGESTED REPAIR SEQUENCING

A. Unless otherwise indicated, perform concrete repairs in the following sequence, with no activity in an area being started until previous activities in that area have been completed, including curing, cleanup, and the like:

1. Removal of equipment, miscellaneous metals, and other surface features that would interfere with the repair;
2. Surface preparation hydroblasting over the entire area to be repaired;
3. Embedded metal repair;
4. Crack repair;
5. Spalled and delaminated concrete repair;
6. Scaled concrete repair;
7. Pop-out repair, and repair of other surface damage, deterioration, or defects;
8. Patching of holes in concrete;
9. New construction; and
10. Application of protective coatings;

B. For areas which require combinations of spalled and delaminated concrete repair, scaled concrete, and pop-out repair, perform these repairs at the same time.

C. Limit the size of the repair area in order to permit the repairs to be performed together, without sacrificing the quality of the individual repairs.

3.03 EMBEDDED METAL REPAIR

A. Unless otherwise indicated, repair anchor bolts, structural steel from temporary support system, and other embedded metal, except rebar, that are exposed at the concrete surface, as follows:

B. Cut off or otherwise remove metal fastened at the surface;

1. Burn back embedded metals to a depth of at least 1.5 inches beyond the surface of sound concrete. When removing hollow structural members, completely fill and patch the void over the entire member thickness;
2. Chip away unsound concrete around the embedded metal.
3. Apply epoxy grout to the repair area until level with the surface of the surrounding sound concrete.

C. Unless otherwise indicated, repair embedded rebar that is exposed at the concrete surface following the procedures outlined in the appropriate concrete repair subsection, below.

3.04 CRACK REPAIR

A. Structural versus Non-Structural Cracks:

1. Cracks are defined by the Owner as non-structural cracks or structural cracks.
2. Repair structural cracks with epoxy resin.
3. Repair non-structural cracks with polyurethane chemical grout.

B. Efflorescence:

1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.
2. Clean the efflorescence by light hydro-blasting or scrubbing.

C. Pressure Injection:

1. General:

a. The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the Contractor and Owner.

b. In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.

2. Structural cracks are to be repaired to deliver a water tight hydraulic structure. Cracks greater than a minimum 0.01-inch are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

   a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.

   b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.

   c. Install the injection ports in accordance with the manufacturer's directions.

   d. Sealing:

      1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.

      2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden.

      3) Use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.

      4) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected polyurethane grout and to prevent wastage. Seal surface of crack with fast setting hydraulic cement or high strength epoxy gel; i.e., Denepox Rapidgel by De Neef Construction Chemicals, Inc. or equivalent. The floor surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work

   e. Inject the repair materials, with consideration of the following items:

      1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

      2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.

      3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

      4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.

   f. Cleanup:

      1) Remove the surface seal by grinding or other appropriate means.

      2) Coat fittings and holes at injection ports with an epoxy patching compound.

      3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3. Non-structural cracks are to be repaired to deliver a water tight hydraulic. Cracks greater than a minimum 0.01 inch are to be injected unless they do not accept grout. Perform

non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.

b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.

c. Install the injection ports in accordance with the manufacturer's directions.

d. Moisture:

1) For non-structural cracks, moisture must be present for the chemical grout to react.

2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.

e. Inject the repair materials, with consideration of the following items:

1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that voids are properly sealed off.

3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.

f. Cleanup:

1) Remove excess surface material by grinding or other appropriate means.

2) Coat fittings and holes at injection ports with an epoxy patching compound.

3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.05 SPALLED AND DELAMINATED CONCRETE REPAIR

A. Repair spalls and delaminated concrete using repair mortar.

B. Surface Preparation:

1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.

2. Boundaries:

a. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one inch deep.

b. Layout boundaries to reduce boundary edge length.

c. Avoid excessive or complex edge conditions.

3. Sawcuts:

a. Perform sawcuts perpendicular to the surface or slightly undercut.

b. Construct sawcuts in maximum 1/4-inch increments.

c. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.

d. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the Owner.

4. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by patching material, whichever is greater.

5. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.

6. Removal:

a. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.

b. Hydroblast removal shall use a maximum pressure of 40,000 psig.

c. Sand blasting is not permitted.

d. Hydroblast concrete removal is recommended for large area of surface defects.

e. Remove water blasting debris daily in order to prevent it from setting up.

f. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.

g. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.

7. Reinforcement:

a. Remove concrete from around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, and if the concrete is unsound or honey-combed.

b. Remove concrete in order to provide a clear space of minimum one inch on each side of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.

c. Clean exposed reinforcement by water blasting or wire brushing.

d. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.

e. Consult with the Owner before adding or replacing rebar.

C. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.

2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.

3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer’s recommendations, allow the coating to dry, reapply the coating, and allow to dry again.

5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

D. Repair Mortar:

1. Apply repair mortar in accordance with the manufacturer's recommendations.
2. Apply a minimum and maximum thickness of each lift of repair material in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.
3. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
4. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
5. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
6. Float-finish the repaired surface using wood or sponge floats.
7. For repaired surfaces to receive a protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.
8. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

E. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
    a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
    b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
    c. Ensure that edges are continuously held in place; and,
    d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.06 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation:

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.
2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psig and maximum pressure of 40,000 psig.
3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.
6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.
7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
10. Float-finish the repaired surface using wood or sponge floats.
11. Provide strip joint in newly placed mortar at the location of repaired cracks.

D. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
    a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
    b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
2. Ensure that edges are continuously held in place; and,
    a. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
3. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
4. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.07 POP-OUT REPAIR, AND REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

A. Repair pop-outs and other surface damage, deterioration, and defects which are 1/4 inch deep or shallower, using the procedures described under "SCALED CONCRETE REPAIR," above.

B. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described under "SPALLED AND DELAMINATED CONCRETE REPAIR," above.

3.08 PATCHING OF HOLES IN CONCRETE

A. General:

1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.
2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.
3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.
4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.
5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude, and roughen larger holes to a minimum of 0.25-inch amplitude.
6. At holes, coat the existing surface to be repaired with a bonding agent.

B. Patching Small Holes:

1. For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout as required in Section 03 60 00.

C. Patching Large Holes:

1. Fill holes which are larger than 12 inches in their least dimension with non-shrink grout.
2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove, approximately 1/16 inch deep.
3. Grind the groove into the interior edge of the hydrophilic waterstop.
4. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.
5. Install the waterstop in accordance with the requirements of Section 03 32 00.
6. Provide reinforcing steel in layers matching existing reinforcement location, except that concrete cover as required in the Contract Documents for the service condition shall be provided.
7. For holes smaller than 48 inches, provide reinforcement consisting of a minimum of No. 5 bars at 12 inches on center in each layer required.
8. At holes larger than 30 inches, drill the reinforcement and grout into the existing concrete.
    a. For holes larger than 48 inches, refer to the Drawings for reinforcement details.

3.09 PATCHING OF LINED HOLES

A. General:

1. This work applies to those openings which have embedded material over all or a portion of their inside edge.
2. The requirements for repairing holes in concrete, as indicated above, apply as modified herein.
3. Owner will determine whether the embedded material is allowed to remain.
    a. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface.
    b. Roughen or abrade the embedded material in order to promote good bonding to the repair material.
    c. Remove substances that interfere with good bonding.

d. Completely remove embedded items that are not securely and permanently anchored into the concrete.

4. Completely remove embedded items which are larger than 12 inches in their least dimension, unless they are composed of a metal to which reinforcing steel can be welded; where reinforcement is required, weld it to the embedded metal.

5. The following requirements shall apply to concrete members which are in contact with water or soil:

   a. Using epoxy grout, fill lined openings which are less than 4 inches in their least dimension;

   b. Using an epoxy bonding agent, coat lined openings which are greater than 4 inches but less than 12 inches in their least dimension, prior to being filled with non-shrink grout.

   c. Using an epoxy bonding agent, coat lined openings which are greater than 12 inches in their least dimension, and provide a hydrophilic waterstop bonded to the interior of the opening with epoxy adhesive, prior to being filled with approved repair material.

END OF SECTION

SECTION 03 11 00
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 15 00 - Concrete Accessories

B. Section 03 20 00 - Concrete Reinforcing

C. Section 03 30 00 - Cast-in-Place Concrete

1.03 DESIGN STANDARDS

A. The formwork shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Guide to Formwork for Concrete" ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. The design and construction of the formwork shall be the responsibility of the Contractor.

B. The 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 all other forces resulting from the movement of the forms.

C. The 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.

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 347R, except as modified below:

1. Variation from plumb in lines and surfaces of piers, walls, or columns
    a. In any 10 feet of length:1/4 inch
    b. Maximum for entire length: 1 inch
2. Variation from the level or from the grades
    a. In any 10 feet of length: 1/4 inch
    b. Maximum for entire length: 3/4 inch
3. Variation of distance between walls, columns and beams
    a. In any 10 feet of distance: 1/4 inch
    b. Maximum for entire distance: 1 inch
4. Variation of the linear lines from established position as indicated on the Plan
    a. In any 20 feet (6 m) of length: 1/2 inch
    b. Maximum for entire length: 1 inch
5. Variation in sizes and locations of sleeves, floor openings, and wall openings

a. Minus: 1/4 inch

b. Plus: 1/2 inch

6. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls

a. Minus: 1/4 inch

b. Plus: 1/2 inch

7. Variations of footing dimensions from plan dimensions

a. Minus: 1/2 inch

b. Plus: 2 inch

8. Thickness ± 5%, up to maximum of 1 inch

1.05 REFERENCE STANDARDS

A. ACI 347R: Guide to Formwork for Concrete

B. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field

1.06 SUBMITTALS

A. Submit manufacturer's literature for form coating.

B. Submit formwork layout plans, design data and procedures if requested by the Engineer.

1.07 DELIVERY, 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 20 00, Section 03 15 00, and Section 03 30 00.

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 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 back from concrete face.

2.04 FORMS - GENERAL

A. Use forms that conform to ACI 347R. Fabricate with facing materials that produce the specified tolerance requirements outlined in Part 1 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 outlined in Part 1 of this Section. The 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 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 by 3/4 inch - 45 degree chamfers, 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 all superimposed dead, temporary construction, and live loads. When forms or shoring are removed, there shall be no excessive deflection or distortion of the concrete. 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. Form removal shall not impair the safety and serviceability of the structure or concrete members.

B. 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. The cylinder strength shall be based on test specimens cured in the field, as described in ASTM C31/C31M, 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 30 00.

C. 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 the Engineer in order to facilitate effective repair of voids or broken corners before the surface has dried.

D. Forms and shoring in the formwork shall not be removed without the approval of the Engineer. The 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 degrees Fahrenheit. The times may be increased or decreased as directed by the Engineer, dependent on air temperatures, cement type, concrete additives or other conditions of the Work in accordance with ACI 347R.

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 the Engineer's review. During reshoring, no construction loads shall be permitted on the new construction.

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 15 00
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 11 00 - Concrete Forming

B. Section 03 20 00 - Concrete Reinforcing

C. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

A. ASTM A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

B. ASTM A194/A194M: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

C. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts

D. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

E. ASTM D994/D994M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

F. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

G. ASTM D1752: Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

H. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

I. ASTM F436/F436M: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions

J. COE CRD-C 513: Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops

K. COE CRD-C 572: Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop

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 the Engineer.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Environmental requirements relative to temperature for placing joint sealants are specified in Part 3 of this Section.

1.06 SEQUENCING

A. Contractor shall sequence installation of miscellaneous embedded items with the Work of Section 03 11 00, Section 03 20 00 and Section 03 30 00.

PART 2 PRODUCTS

2.01 JOINT FILLER

A. Preformed Expansion Joint Filler for Concrete (Bituminous Type) ASTM D994/D994M.

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 D6690, Type II or III.

2.03 WATERSTOPS

A. PVC waterstops shall conform to COE CRD-C 572 polyvinyl chloride (PVC) or COE CRD-C 513 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 A193/A193M Grade B7, ASTM A194/A194M Grade 2H or ASTM A563/A563M Grade DH nuts, and ASTM F436/F436M washers; plated in accordance with ASTM B633, 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 B633, 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 B633, SC1, Type III or Type 304 stainless steel anchor body, washers, nuts and wedges when so indicated on plans.

PART 3 EXECUTION

3.01 VERIFICATION

A. Inspect the locations and surfaces to receive joint filler, joint sealer, 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 the Engineer.

3.04 INSTALLATION OF JOINT SEALANTS

A. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees Fahrenheit. Bond breaker and backup material shall be installed where required as indicated on the Plans or manufacturer's recommendations.

3.05 INSTALLATION OF WATERSTOPS

A. Waterstops shall be of maximum practicable length to minimize joints.

B. Waterstops shall be positioned as indicated on the Plans in a manner to permanently retain flexibility.

C. Splice in length or at intersections shall be performed by heat sealing and in accordance with manufacturer's recommendations.

D. Reform splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. When cooled and bent by hand in as sharp as an angle as possible, the splice shall show no sign of separation.

E. Provide support and protection of the waterstops during the progress of the work. Any waterstop punctured or damaged shall be replaced or repaired at Contractor's expense. Concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.06 CONCRETE ANCHORS

A. Do not begin installation until substrates have been properly prepared. Do not proceed with installation if substrate preparation is unsatisfactory.

B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install in accordance with manufacturer's instructions and recommendations and as required by applicable code. Anchor applied items neatly, with item mounted plumb and level unless otherwise indicated.

D. Engineer reserves the right to require the anchor manufacturer's representative to demonstrate proper installation procedures for post-installed anchors and to observe Contractor's installation

procedures, at no extra cost to Owner. Engineer reserves the right to require pullout or shear tests to determine adequacy of anchors, at no extra cost to Owner.

3.07 MISCELLANEOUS EMBEDDED ITEMS

A. Inserts 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 20 00
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 11 00 - Concrete Forming

B. Section 03 15 00 - Concrete Accessories

C. Section 03 30 00 - Cast-in-Place Concrete

1.03 ALLOWABLE TOLERANCES

A. Fabrication:

1. Sheared length: ±1 inch
2. Depth of truss bars: +0, -1/2 inch
3. Stirrups, ties, and spirals: ±1/2 inch
4. Other bends: ±1 inch.

B. Placement:

1. Concrete cover to form surfaces: ±1/4 inch
2. Minimum spacing between bars: -1/4 inch
3. Top bars in slabs and beams:
   a. Members8 inches deep or less: ±1/4 inch
   b. Members more than 8 inches but not 24 inches over deep: ±1/2 inch
   c. Members more than 24 inches deep: ±1 inch
4. Crosswise of members: Spaced evenly within 2 inches of stated separation.
5. Lengthwise of members: ±2 inches
6. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1-bar diameter, with approval from the Engineer.

1.04 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 the Engineer.

B. Contractor may be required to furnish additional test of reinforcing steel for each 100 ton or fraction thereof. Testing for bend, pull, elongation and weight to assure compliance with Specifications shall be in accordance with ASTM A370.

1.05 REFERENCE STANDARDS

A. ACI SP-66: ACI Detailing Manual

B. ACI 301: Specifications for Concrete Construction

C. ACI 318: Building Code Requirements for Structural Concrete and Commentary.

D. ASTM A184/A184M: Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement

E. ASTM A370: Standard Test Methods and Definitions for Mechanical Testing of Steel Products

F. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

G. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

H. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

I. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

J. ASTM C55: Standard Specification for Concrete Building Brick.

K. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

L. CRSI (DA4): Manual of Standard Practice

1.06 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.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to Project site in bundles tagged and marked in accordance with CRSI (DA4).

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.

1.08 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/A615M, Grade 60.

2. Rail-Steel and Axle Steel Deformed and Plain Bars: ASTM A996/A996M, Grade 60.

3. Low Alloy Steel Deformed Bars: ASTM A706/A706M.

C. Mats:

1. Fabricated steel bar or rod mats of the clipped type shall conform to ASTM A184/A184M.

2.02 WELDED WIRE FABRIC

A. Welded wire fabric shall be in flat mats only.

B. Plain:

1. Conform to ASTM A1064/A1064M, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

C. Deformed:

1. Conform to ASTM A1064/A1064M, 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 A1064/A1064M, 16-gage minimum size.

B. Deformed:

1. Conform to Deformed Steel Wire for Concrete Reinforcement, ASTM A1064/A1064M, 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 non-stainless wire will lie no closer than 1/4 inch 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. 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.

B. 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	6 bar diameters
#9, #10 and #11	8 bar diameters
#14 and #18	10 bar diameters

C. Bends for stirrups and ties with number #5 bar and smaller shall not be less than four bar diameters. For bars larger than No.#5, shall be according to the “Minimum Diameter of Bend” table above.

D. 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 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. 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 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 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 for slabs and walls and 1-1/2 inches 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.

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 1 inch 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. 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, 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. 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 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. The fabric shall extend across

supporting beams and walls and to within four 4 inches 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 ensure its proper position in the slab either by the methods of Part 3 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 ensure proper placement, templates shall be furnished for all column dowels.

F. Bars of size #14 and #18 or larger, where size #11 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 #11 may be butt spliced by mechanical devices approved by the 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 CRSI (DA4).

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 the Engineer prior to placement of concrete.

B. Contractor shall avoid displacement of the reinforcing steel during concrete placement.

END OF SECTION

SECTION 03 30 00
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 33 00 - Submittal Procedures

B. Section 03 15 00 - Concrete Accessories

C. Section 03 20 00 - Concrete Reinforcing

D. Section 03 60 00 - Grouting

E. Section 05 12 00 - Structural Steel Framing

F. Section 07 10 00 - Dampproofing and Waterproofing

G. Section 31 23 19 - Dewatering

1.03 REFERENCE STANDARDS

A. ACI 312.3R: Report on Chemical Admixtures for Concrete

B. ACI 301: Specifications for Concrete Construction

C. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete

D. ACI 305R: Guide to Hot Weather Concreting

E. ACI 306R: Guide to Cold Weather Concreting

F. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete

G. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

H. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field

I. ASTM C39/C39M: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

J. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete

K. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete

L. ASTM C150/C150M: Standard Specification for Portland Cement

M. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete

N. ASTM C183: Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement

O. ASTM C231: Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

P. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete

Q. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

R. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete

S. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements

T. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

U. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars

V. ASTM D75 / D75M - 19 Standard Practice for Sampling Aggregates

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.

B. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.05 TESTING AGENCY

A. Inspections and tests required by this Section shall be performed by organizations acceptable to the Engineer.

1.06 ALLOWABLE TOLERANCES

A. See Section 03 11 00 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 the 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 a 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
2. Fine Aggregate: 2,000 tons

3. Coarse Aggregate: 2,000 tons

D. Use same brand cement for any given structure produced by a single mill unless otherwise provided by authorization of the 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 the 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 the Engineer with a written request for approval. No concrete shall be placed until the Contractor has received such approval in writing.

D. 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 designation, 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.

E. Submit manufacturer's literature of abrasive wear resistant floor finish and of chemical curing compound for review by the Engineer.

F. Submit a sample concrete delivery ticket for review by the Engineer.

G. 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.

H. Submit reports of the sampling and testing of slump, air content and strength performed.

I. 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 304R and as specified below.

B. When permission is given to store cement in the open, a floor at least 6 inches 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 the 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 305R for hot weather concreting, and ACI 306R for cold weather concreting.

B. Specific temperature requirements are contained in Part 2 of this Section for mixing and Part 3 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 the Contractor.

C. Testing and inspection required due to substitution or change of materials requested by the Contractor shall be at the Contractor's expense.

2.02 CEMENT

A. Cement shall be the type as indicated on the Plans or as specified.

1. Type I and IA, conforming to ASTM C150/C150M, air-entraining Portland cement when special properties are not specified.

2. Type III and IIIA, conforming to ASTM C150/C150M, air-entraining Portland cement for use when high-early strength is specified.

3. Type IS and IS-A, conforming to ASTM C595/C595M, air-entraining Portland blast-furnace slag cement for use in general concrete construction.

4. Type IP and IP-A, conforming to ASTM C595/C595M, 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. Class17A for members 8 inches or less in thickness and Class 6AA for other construction.

1. Gravel shall consist of hard, clean, durable particles of rock or pebbles and shall be free from lumps of clay.

2. 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.

3. All 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."

C. Fine aggregate shall be sand size 2NS, MDOT, Section 902.08.

1. 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.

2. 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/C260M.

2. Pozzolan and Fly Ash, conforming to ASTM C618, Class F.

3. Water reducing, conforming to ASTM C494/C494M.

4. Retarder, conforming to ASTM C494/C494M.

5. Plasticizer, conforming to ASTM C494/C494M.

6. Ground granulated blast furnace slag conforming to ASTM C989/C989M, 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 15 00.

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, Class F Fly Ash, and water with admixtures if required. Admixtures shall not be used without the Engineer's review.

B. The mixture, combined in proportions, shall meet the requirements of MDOT, Specification Section 701, and ACI 211.1.

C. 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 68 - 75 degrees F. The desired strength of the concrete shall be shown on either the Plans or in the Specifications.

D. 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, unless otherwise shown on the plans.

Table 1 - Concrete Mixtures

Concrete Grade	Coarse Agg	Type of Cement	Cement Content (lbs/yd3)	Min Compressive Strength @ 28 days	Min Modulus of Rupture @ 28 days	% Air
5.0	6AA	I, IA, IS, IS-A	658 lbs/cyd	4500 psi	750 psi	4 - 6
4.0	6AA or 17A	I, IA, IS, IS-A	611 lbs/cyd	4000 psi	700 psi	4 - 6
3.5	6AA or 17A	IS, IS-A, IP, IP-A	564 lbs/cyd	3500 psi	650 psi	4 - 6

1. Maximum water cement ration shall be 0.45.
2. Structural concrete for walls and slabs shall be placed with a slump of 4 inches 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.
5. Maximum total replacement of cement shall not exceed 40%.

E. Aggregates shall be proportioned by weight, except for small structures and for incidental Work requiring less than 10 cubic yards of concrete, in which case they may be proportioned by volume when approved by the Engineer.

F. Cement in bulk, when permitted, shall be proportioned by weight.

G. 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 yard.

H. 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 one (1) percent in any one (1) 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 212.3R.

B. If the air content is found to be less or greater than the specified amount, the 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 the 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 the Engineer 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 exceed165 degrees F. The cement shall be stored at the Contractor's expense until cooled to that temperature.

B. The temperature limits of aggregates and water entering the mixer shall be as follows:

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. 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 the 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. The 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 1 cubic yard, with an additional 15 seconds for each additional 1 cubic yard.
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. The concrete at the point of delivery shall have the proper consistency and shall be free from segregation.
9. 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.
10. 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/C94M. If transit-mix concrete is used, it shall meet all the foregoing requirements specified for central mixed concrete and, in addition, the following:

a. The 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 the 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. Any concrete which remains in the mixer after this period and any concrete which appears too stiff to be properly workable or which appears to have begun to take its initial set shall be rejected and removed from the site of the Work.

D. Owner may employ an independent testing laboratory to provide a qualified inspector to be present at the plant where batching of concrete occurs. The inspector shall verify the compliance of the mix with the Specifications and shall sign a form indicating the quantity of concrete and the concrete mixture of each load.

2.12 CHANGE OF MIXTURE

A. If Contractor requests a change or substitution of approved batch proportioning, mixing, or delivery operations additional testing and/or inspection shall be at Contractor's expense.

2.13 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of abrasive wear resistant floor finish include: Master Builders Company "Mastercon Aggregate," Sonneborn Building Products "Harcol," or equal.

PART 3 EXECUTION

3.01 VERIFICATION OF FORMWORK, REINFORCING, AND SUBGRADES

A. Contractor shall inspect formwork, reinforcement and subgrades to confirm compliance with the related Work specified elsewhere.

3.02 EMBEDDED ITEMS

A. Contractor shall verify the location, from certified vendor or applicable engineering drawings, of all embedded items including anchor bolts, wall sleeves, wall casting, railing post sleeves and miscellaneous pipes and conduits and shall install the items accurately at the locations determined.

3.03 BUILDING IN OTHER WORK

A. Contractor shall make all necessary provisions in concrete Work for other Work installed by this or other contractors, and build in all required steel beams, frames, curbs, expansion joints, inserts, hangers, pipes, floor drains, pipe trench covers and frames, anchors, sleeves, floor ducts, fiber and steel conduit, pipe hanger sockets, and all other Work furnished by either this or other contractors.

B. Contractor shall build in all anchors, ties, etc., specified under brick and other Work, in faces of concrete Work which are to be faced with masonry, and any other Work shown or noted to be built into concrete. In addition, Contractor shall provide all openings and holes in concrete Work as shown or as needed to accommodate other Work.

3.04 SPECIAL CONCRETE

A. Contractor shall verify the use and/or locations of watertight concrete and/or high-early strength concrete.

3.05 PREPARATION

A. Contractor shall notify the 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 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, the Contractor shall bridge the subgrade with at least 2000 psi, 3 inch 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 23 19, and not until after the 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. The use of drop chutes, except at or in the forms, is prohibited.

B. The 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 five (5) times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2 square feet.

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 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 the Engineer. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or heavy duty flexible rubber hose. The inside diameter of the pipe shall be at least three (3) times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. The maximum size coarse aggregate shall not be reduced to accommodate the pumps.

E. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The 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 3 feet 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 inch 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 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 of vertical height. Concrete in walls or columns shall set at least two (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. All 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 the 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 - 30 inches apart, but shall not be used to transport concrete within the forms. Contractor shall have a stand by 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 as measured from a 10 foot 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 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.

B. The 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 the Owner.

3.11 EXPANSION JOINTS

A. Comply with the requirements of Section 03 15 00. 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 seven (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. The 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, 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 inch 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. 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, the 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 degrees F, 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 degrees F.

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 - 70 degrees F, at all times for at least five (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 degrees F.

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 per cubic yard 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 the Engineer upon delivery. The 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 the 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. Tests shall be made of fresh concrete for each 50 cubic yards, or whenever consistency appears to vary. The sampling and testing of slump, air content and strength will be performed at no cost to the Contractor.

B. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172/C172M.

C. Slump Test:

1. Slump Test shall be in accordance with ASTM C143/C143M. 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 above the indicated maximum slump shall be allowed for individual batches provided the average for all batches or the most recent ten (10) batches tested, whichever is fewer, does not exceed the maximum limit.

D. Air Content:

1. Air content of normal weight concrete will be determined in accordance with ASTM C231, Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.

E. Compressive Strength:

1. A set of cylinders for compressive strength tests will consist of four cylinders per each set. The temperature of concrete sample will be determined for each strength test.

2. Molding and curing specimens from each set shall be in accordance with ASTM C31/C31M. Any deviations from the requirements of this Standard shall be recorded in the test report.

3. Testing specimens will be in accordance with ASTM C39/C39M. One (1) specimen shall be tested at seven (7) days for information and two (2) shall be tested at 28 days for acceptance.

a. Acceptance test results shall be the average of the strengths of the two (2) specimens tested at 28 days. If one (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.

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 the Contractor.

B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by the 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 the Engineer, cores at least 2 inch in diameter shall be obtained and tested in accordance with ASTM C42.

1. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 80° Fahrenheit (15°to 25° Celsius), relative humidity less than 60%) for 7 days before test and shall be tested dry.

2. 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.

D. At least three (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 the 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.

E. 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.

F. 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, the 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, the 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 the Engineer.

3.20 DEFECTIVE CONCRETE

A. If, in the opinion of the 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 the 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

SECTION 03 32 00
CONSTRUCTION AND EXPANSION JOINTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. The following is a list of standards and publications referenced in this section:

1. American Society for Testing and Materials (ASTM) Publications:

a. ASTM C 920: Specification for Elastomeric Joint Sealants.

b. ASTM C 962: Guide for Use of Elastomeric Joint Sealants.

c. ASTM D 1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

d. ASTM D 2628: Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

e. ASTM D 2835: Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.

2. Corps of Engineer's Spec. CRD-C572: Specification for Polyvinylchloride Waterstop.

3. Journal of the American Concrete Institute, June 1959: Waterstops for Joints in Concrete by B. Kellam and M.T. Loughborough.

1.02 SUBMITTALS

A. Shop Drawings:

1. Product data for materials including location where product is to be used.

2. Certification that materials meet the specifications.

3. Testing laboratory data substantiating results of waterstop zero water leakage tests conforming to test arrangement in the 1959 Journal of the ACI.

4. Manufacturer's application and installation instructions.

5. Samples of waterstops and joint fillers.

6. Color samples or charts for joint compounds.

7. Submit record documents and shop drawings marked to record actual construction.

PART 2 PRODUCTS

2.01 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in the manufacturer's sealed bags, unopened containers and banded pallets.

B. Store materials off ground on platform or skid supports, and protect with covers from snow, rain and ground splatter.

C. Store plastic products under cover in a dry cool location out of direct sunlight.

2.02 JOINT COMPOUNDS

A. In surface facilities, provide joint compound for joints in horizontal and inclined surfaces less than 30 degrees from the horizontal conforming to ASTM C 920, Type S or M, Grade P, Class 25. Provide type T compound in pedestrian and vehicular traffic areas, and type NT in non-vehicular areas. Provide preformed joint seals where indicated.

B. In surface facilities provide joint compound for joints in walls inclined surfaces greater than 30 degrees from the horizontal conforming to ASTM C 920, Type S or M, Grade NS, Class 25.

C. Provide compatible joint compounds as recommended by manufacturer when they abut each other.

D. Provide compound made for continuous submergence in liquid containing structures.

E. Provide preformed polychloroprene elastomeric joint seal (compression seal) made of vulcanized elastomeric compound using polychloroprene as the only base polymer. Provide in expansion joints where indicated and conform to ASTM D 2628.

F. Provide one-component polychloroprene compound conforming to ASTM D 2835 as lubricant for installation of elastomeric joint seal.

2.03 BOND BREAKER FOR JOINT COMPOUNDS

A. Provide polyethylene tape, coated paper, or metal foil.

2.04 BACK-UP MATERIAL FOR JOINT COMPOUNDS

A. Provide 100 percent closed-cell material, compressible, nonshrink, nonreactive with joint compound, and nonabsorbent.

B. Extruded butyl or polychloroprene foam rubber is acceptable.

C. Material impregnated with oil, bitumen, or similar substances is not acceptable.

D. Provide back-up material which is compatible with joint compound as recommended by manufacturer and has same expansion/contraction capability as compound.

2.05 PREMOLDED-JOINT FILLER

A. Provide premolded-joint filler conforming to ASTM D 1752, Type I or Type II.

B. Provide joint filler having same thickness as expansion joint width indicated.

C. Provide maximum length filler manufactured to minimize field cutting.

2.06 POLYVINYLCHLORIDE WATERSTOP

A. Provide in accordance with Corps of Engineer's Specification CRD-C572.

B. Provide waterstops of type and size indicated with looped galvanized steel wire along both edges. Manufacture from virgin polyvinyl chloride plastic compound that has a minimum tensile strength of 1750 psi.

C. Provide waterstops having zero water leakage when tested to 50 psi minimum water pressure conforming to test arrangement in the 1959 Journal of the ACI.

D. Provide factory-made and tested crosses, tees, and ells, manufactured using thermostatically controlled electric heat source.

E. PVC waterstops to be manufactured by:

1. Catalog No. RB9-12 as manufactured by Vinylex Corporation, Knoxville, TN.
2. Wirestop Waterstop Part # CR-9380 as manufactured by Paul Murphy Plastics, Roseville, MI.
3. No. 735 as manufactured by Greenstreak Plastic Products Company, St. Louis, MO.
4. Or accepted equivalent product.

F. Provide hydrophilic rubber gasket waterstops as manufactured by:

1. Duroseal Gasket Waterstop manufactured by BBZ USA, Southington, CT;
2. Adeka Ultraseal MC-2010M manufactured by Adeka North America, Spearfish, SD;

3. Swellseal 8 manufactured by de neef Construction Chemicals, Inc., Waller, TX;

4. Or equal.

2.07 HYDROPHILIC PASTE WATERSTOPS

A. Provide hydrophilic rubber paste waterstops of urethane paster, thixotropic vinyl monomer or similar materials.

B. Hydrophilic rubber paste shall be compatible with waterstop material.

C. Hydrophilic paste shall be 100% solids.

D. Provide hydrophilic paste waterstops which meet or exceed the criteria in the following table:

Property	Test Methods	Limit
Ultimate Elongation	ASTM D 638	50% minimum
Tensile Strength	ASTM D 638	25 psi [170 kPa]
Ozone Resistance	ASTM D 1149	No Failure
Volatile Loss	ASTM D 1203	0.50% maximum
Hardness, Shore A	ASTM D 2240	20 to 60

E. Provide hydrophilic rubber paste as manufactured by:

1. Duroseal Paste manufactured by BBZ USA, Southington, CT:

F. Adeka Ultraseal P-201 manufactured by Adeka North America, Spearfish, SD;

1. Swellseal Cartridge manufactured by De Neef Construction Chemicals, Inc., Waller, TX;

PART 3 EXECUTION

3.01 GENERAL

A. Do not omit, add, or relocate construction and expansion joints without acceptance of the Engineer.

B. Cast slabs and beams monolithically without horizontal joints.

C. Do not use horizontal joints within footings and foundation mats.

D. Place waterstops in joints, in location indicated, before concrete placement.

E. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.

F. Reject before placing concrete, all waterstops bent around corners and remove from the construction or expansion joint and replace with factory-made pieces at no additional cost to the NEORSD.

G. Spark test all waterstop splices before installation in accordance with manufacturer's instructions.

H. Clean all expansion joint sidewalls before installing joint compound and compression seals.

3.02 JOINT PREPARATION

A. General:

B. The joints shall be accurately located and constructed to produce straight joints; and shall be vertical or horizontal, except where walls intersect sloping floors.

1. The concrete pour shall not commence until after the joint preparation has been inspected by the Engineer.

C. Preparation of Construction Joints:

1. The Contractor shall terminate each day's pour with a construction joint, as shown on the Drawings or as approved by the Engineer, and a suitable bulkhead.
2. Maintain on hand, at all times, sufficient keyway material, waterstops, and dowels for emergency use if a construction joint is required due to stoppage of concrete pour because of an emergency shutdown.
3. Temporary stoppage of pouring concrete may result in a cold joint. Prior to resuming concrete placement on this plane, the surface shall be thoroughly cleaned of all laitance, loose or defective concrete, coatings, sand and other foreign material. The surface shall be prepared to a sufficient depth to expose sound concrete. Immediately prior to covering with fresh concrete the joint shall be wet sandblasted, washed with air-water jet and surface dried.

3.03 CONSTRUCTION JOINTS

A. Prior to placing the abutting concrete, the contact surface shall be prepared according to this Section. The exposed portion of the reinforcing steel shall be cleaned of all concrete.

B. Roughen the surface of the hardened concrete by one of the following methods:
1. Sandblasting the foundation and reinforcing dowels after the concrete has fully cured to remove all laitance and spillage, and to expose sound aggregate.
2. Water blasting the foundation and reinforcing dowels after the concrete has partially cured to remove all laitance and spillage, and to expose sound aggregate.
3. In no case shall the roughening process cause microfractures on the treated surface.

C. At least 2 hours must elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.

D. Furnish key groove with key width one-third the thickness of the member in which the key is placed and a key depth of 1½-inch, unless otherwise indicated.

E. Use tapered key groove forms, with taper being no greater than 2 inches per foot, to permit form removal without damage to groove after concrete has cured.

F. Center waterstops in construction joints unless otherwise indicated.

G. Secure waterstops in position by tie wire from loops to adjacent reinforcement every 12 inches along each edge both sides.

H. Consolidate concrete during placement adjacent to key groove and around waterstop.

I. Do not remove key groove forms until after concrete has been cured for 24 hours.

J. Key groove forms left in place are not acceptable.

K. Clean key groove of laitance, curing compound, foreign materials, protrusions of hardened concrete, roughen and blow out debris and dust with oil-free compressed air.

L. Protect exposed key groove from damage.

3.04 EXPANSION JOINTS

A. Provide expansion joints as indicated.

B. Center waterstops in expansion joints unless otherwise indicated.

C. Secure waterstops in position by tie wire form loops to adjacent reinforcement every 12 inches along each edge both sides.

D. Consolidate concrete during placement adjacent to expansion joint and around waterstop.

3.05 POLYVINYLCHLORIDE WATERSTOPS

A. Provide waterstops in continuous lengths to minimize field splices.

B. Bending waterstops in forms is not permitted. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.

C. Split waterstops are not permitted.

D. Make all splices on a bench following manufacturer's splicing procedures and instructions.

E. Maintain continuity through splice of characteristic features of waterstop cross-section, including ribs and center bulb.

F. Remove looped steel wire along both edges of waterstop adjacent to saw-cut ends prior to splicing.

G. Make splices by heat sealing adjacent surfaces using a thermostatically controlled electric heat source in accordance with manufacturer's printed instructions.

H. Reform waterstop at splices using a remolding iron having pattern matching waterstop.

I. After splice has cooled, spark test all splices in accordance with manufacturer's printed instructions. If splice shows any separation or lack of fusion reject the splice, recut back at least one inch from rejected splice each side, reweld and retest.

J. Position and tie waterstop to form a continuous, watertight diaphragm in joint, to prevent leakage.

K. Support and protect waterstop.

L. Replace or repair, in accordance with manufacturer's printed instructions, damaged or punctured waterstop.

M. Clean waterstop of curing compound, foreign materials, and protrusions of hardened concrete.

N. Consolidate concrete during placement adjacent to waterstop.

O. Maintain 2 inches minimum clearance between waterstop and reinforcement, and all embedded items.

3.06 PREMOLDED-JOINT FILLER

A. Treat cut surface as recommended by manufacturer, when strips are cut.

B. Place against the bulkhead form and fasten to the inside of the form with non-corrodible fasteners.

C. Prevent disturbance of or damage to joint filler.

D. Fill expansion joint completely.

E. Secure wood strips to surfaces which are to receive joint compound.

F. Use tapered wood strips with the smaller width being the same width as the expansion joint and of depth to install the joint compound and back-up materials as recommended by manufacturer.

G. Use materials to secure joint filler and wood strips which will not harm concrete or affect the joint compound's bond to concrete.

H. Do not remove wood strips until after the concrete curing period.

I. Clean groove of laitance, curing compound, foreign materials, protrusions of hardened concrete; blow out dust with oil-free compressed air.

3.07 JOINT COMPOUND

A. Seal, clean and dry concrete in accordance with manufacturer's printed instructions.

B. Install back-up and bond breaker materials to prevent 3 sided bending.

C. Prime concrete, fill flush with joint compound of required thickness, tool to concave joint and seal, all in accordance with the manufacturer's instructions, and ASTM C 962.

D. Prevent spilling compound over adjoining surfaces. Use tape adjacent to joint if required. Remove all tape completely from concrete surface.

E. Do not seal when compound, air, or concrete temperature is less than 40 F.

3.08 PREFORMED ELASTOMERIC JOINT SEAL

A. Remove all joint fillers as recommended by manufacturer for installation of compression seal.

B. Sandblast without damaging, the exposed joint faces until the surfaces are free of dust, dirt, curing compound, joint filler, and any other material that might prevent readily inserting and bonding of the joint seal to the concrete or stainless steel.

C. Clean and dry expansion joints. The atmospheric and pavement temperatures must be above 40 F at the time of joint seal installation.

D. After final cleaning and immediately prior to joint seal installation, blow-out the expansion joints with oil-free compressed air and leave completely free of sand and water.

E. Lubricate and install the joint seal in accordance with the manufacturer's printed instructions.

F. Install the joint seal in the upright position and free form twisting, distortion and stretching that exceeds 5 percent. Install the joint seal to a depth of 3/16-inch, ±1/16-inch, from the finished surface.

G. Make butt joints and intersecting splices with full contact. Use adhesive recommended by the seal manufacturer. Remove all dust, grease, or substances impeding the formation of the seal.

H. When rain interrupts sealing operations, reclean and redry expansion joints prior to installing the joint seal.

I. If joint seals in place fail to meet specified requirements remove them and install new seals at no additional cost to the NEORSD.

3.09 HYDROPHILIC WATERSTOP

A. Use only where specifically shown in the Drawings or approved by the Engineer.

B. Install in accordance with the manufacturer’s written instructions.

C. Locate the waterstop within the two curtains of vertical wall reinforcing bars as shown or provide a minimum of 2-1/2 inches of concrete cover over the waterstop.

D. Apply adhesive to concrete surface and allow drying for specified time before applying waterstop strip.

E. Butt ends of waterstop strip together at splices and corners and joins with sealant.

F. For vertical and overhead applications, apply adhesive and secure waterstop with concrete nails as 12-inch maximum spacing.

G. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.

END OF SECTION

SECTION 03 34 00
CONTROLLED LOW STRENGTH MATERIAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide Controlled Low Strength Material (CLSM or LSM), complete and in place, in accordance with the Contract Documents.

B. CLSM shall be placed where indicated and may be used, if the Owner approves, for the following purposes:

1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill and trench zone fill.

2. Backfill CLSM shall be used adjacent to and above structures where structure backfill is indicated or in place of granular backfill at the Contractor's option. Additionally, Backfill CLSM shall be used for pipe abandonment and structure cavity fill.

1.02 CONTRACTOR SUBMITTALS

A. Shop Drawings:

1. CLSM mix designs which show the proportions and gradations of materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.

2. If the Contractor proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33 - Concrete Aggregate, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to the Owner.

3. The cost of batch laboratory tests on CLSM, and it components, shall be the Contractor's responsibility.

1.03 QUALITY ASSURANCE AND QUALITY CONTROL

A. Testing will be performed by a testing laboratory selected by the Owner at the Owner's expense, except as otherwise indicated.

B. If tests of the CLSM show non-compliance with the specifications, the Contractor shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be the Contractor's responsibility.

C. Correlation Tests

1. Contractor shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days after placing CLSM.

2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the Work. The proposed location shall be acceptable to the Owner.

3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. Tests shall be performed by a laboratory at the Contractor's expense.

4. Testing shall be performed once every 2 hours during the first 8 hours, once every 8 hours during the first week, and once every 24 hours until the CLSM mix reaches the design strength.

a. Compression testing shall be in accordance with ASTM D 4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

b. Setting test shall be in accordance with ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance

c. Density tests shall be in accordance with ASTM C 138 – Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

PART 2 PRODUCTS

2.01 CONTROLLED LOW STRENGTH MATERIAL

A. CLSM shall be a mixture of cement, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94 - Ready Mixed Concrete.

1. For CSLM used as backfilling within the right of way, shall conform to the City of Cleveland CLSM requirements.

B. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.

1. Mix proportions as necessary.

2. Entrained air content shall be between 0 percent minimum and 30 percent maximum.

3. Water reducing agent content as necessary.

C. Properties:

1. Normal CLSM density shall be between 120 PCF minimum and 145 PCF maximum.

2. Backfill CLSM density shall be between 100 PCF minimum and 125 PCF maximum.

3. Slump shall be as required by the Contractor's methods but shall not promote segregation nor shall slump exceed 9 inches.

4. Backfill CLSM used for pipe abandonment shall be highly flowable having a minimum 8 inch spread with no noticeable segregation when tested in accordance with ASTM D 6103.

D. Compressive strength at 28 Days:

a. Normal CLSM: Between 100 psi minimum and 300 psi maximum. Unless specifically indicated otherwise, CLSM shall be Normal CLSM.

b. Backfill CLSM: Between 50 psi minimum and 150 psi maximum.

2.02 CEMENT

A. Cement shall be Type I or Type II in accordance with ASTM C 150 - Portland Cement.

2.03 POZZOLAN

A. Pozzolans are not permitted.

2.04 AGGREGATE

A. Fine aggregate shall conform to ODOT Specification 703.03 Fine Aggregate for mortar or grout. The use of foundry sand or core sand is prohibited.

2.05 ADMIXTURES

A. Air entraining admixtures shall be in accordance with ASTM C 260 - Air-Entraining Admixtures for Concrete.

B. Water reducing admixtures shall be in accordance with ASTM C 494 - Chemical Admixtures for Concrete.

2.06 WATER

A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 EXECUTION

3.01 PREPARATION

A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 23 00 – Excavation and Backfill.

3.02 BATCHING, MIXING AND DELIVERY

A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the OWNER and shall be delivered in standard transit mix trucks.

3.03 PLACEMENT

A. CLSM shall be placed from a ready-mix truck using conveyor belts, pumping equipment concrete chutes or other approved means. Placement of CLSM from a dump truck tailgate is not permitted. CLSM shall be directed in place by vibrator, shovel, or rod to fill crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.

B. CLSM shall be continuously placed against fresh material unless otherwise approved by the Owner or indicated in the Contract Documents. When new material is placed against existing CLSM, the placement area shall be free from loose and foreign material. The surface of the existing material shall be soaked a minimum of one hour before placement of fresh material, but no standing water shall be allowed when placement begins.

C. Temperature of the CLSM shall be between 50 and 90 degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

D. CLSM shall not be placed above the frost line, or closer than 3 feet from final grade unless otherwise shown on the drawings.

E. CLSM shall not be placed in contact with aluminum pipe or fittings, or aluminum and aluminum-coated culverts.

3.04 FINISHING

A. The finish surface shall be smooth and to the grade indicated or directed by the Owner. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.05 CURING

A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.

3.06 PROTECTION

A. CLSM shall be protected from freezing for 72 hours after placement.

B. Apply no loads including fill and construction traffic loads to CLSM until it has gained sufficient strength to bear the load without loss of strength. As a minimum, apply no loads for a period of 48 hours following placement, or until ball drop tests conforming to ASTM D 6024 - Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application show an indentation of 3 inches or less, or until a compressive strength of 15 psi is demonstrated by testing acceptable to the Owner.

C. CLSM shall be protected from running water, rain, and other damage until the material has been accepted and final fill completed.

D. CLSM shall not be exposed to vehicular construction traffic other than the minimum necessary to cover with subbase or base material, temporary pavement, fill or the like.

END OF SECTION

SECTION 03 41 00
PRECAST CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes precast structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other elated items such as anchorage, bearing pads, storage and protection.

1.02 RELATED WORK SECTIONS

A. Section 03 20 00 - Concrete Reinforcing

B. Section 03 60 00 - 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. AASHTO - American Association of State Highway and Transportation Officials
2. ACI - American Concrete Institute
3. AWS - American Welding Society
4. ASTM- American Society for Testing and Materials
5. PCI - Precast and Prestressed Concrete Institute

1.04 QUALIFICATIONS

A. Manufacturer shall be a company specializing in providing precast concrete products and services normally associated with the industry for at least five (5) years. When requested by the Engineer, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.

B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.

C. Welders shall have qualified within the past year in accordance with AWSD 1.1.

1.05 DESIGN CRITERIA

A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast concrete design.

B. Use in the design, applicable codes, ACI 318, or AASHTO Standard Specifications for Highway Bridges. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.

C. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16(HL-93) loading and installation conditions.

1.06 REFERENCE SPECIFICATIONS

A. All local codes plus the following Specifications, standards and codes are a part of these Specifications:

1. ACI 318 -Building Code Requirements for Reinforced Concrete.
2. AWS D1.1 -Structural Welding Code.
3. AWS D1.4 -Reinforcing Steel Welding Code.

4. AASHTO Standard Specifications for Highway Bridges.

1.07 ALLOWABLE TOLERANCES

A. Design deviations may be permitted only after the Engineer's review of the manufacturer's proposed design supported by complete design calculations and drawings.

B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to the OWNER.

1. Length: +/- 1/8 inch per 10 feet (1 mm per meter), +/- 1/4 inch (5 mm) maximum

2. Cross sectional dimensions:

a. Less than 24 inches (600 rnm) +/- 1/4 inch, (5 rnm) 24 to 36 inches (600 to 900 rnm): +/- 3/8 inch (9 mm)

b. Over 36 inches (900 rnm):+/- 1/2 inch (10 rnm)

3. Thickness: +/-1/4 inch (5 mm)

4. Position of anchors and inserts: +/- 1/2 inch (10 mm) of centerline location shown on the Plans.

5. Horizontal alignment or sweep: 1/4 inch (5 mm) total or 1/8 inch per to-foot length (1 mm per meter), whichever is greater. Maximum of ½- inch (10 mm) gap between two (2) adjacent members due to sweep.

6. End squareness: 3/8 inch (9 mm) maximum

7. Blockouts: +/- 1/2 inch (10 mm) off centerline locations shown on the Plans.

8. Out of square: 1/8 inch per six (6) feet (5 rnm per 3 m) measured on the diagonal.

9. Warpage, after installation: 1/8 inch per 6-foot (5nnn per 3 m) length, or 3/8 inch (9 mm), whichever is greater.

C. Vertical alignment:

a. Bottom edges of members from line established at lower face: +/- 1/4 inch (5 mm).

b. Bottom surface from straight line between supports: 1/240 of clear span.

1.08 SOURCE QUALITY CONTROL

A. Comply generally with applicable provisions of Prestressed Concrete Institute MNL-116, Manual for Quality Control for Plants and Production of Precast, Concrete Products.

1.09 SUBMITTALS

A. Contractor shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of this Section.

B. Submit erection or production drawings showing:

1. Drawings and/or elevations locating and defining all material furnished by manufacturer.

2. Sections and details showing connections, cast-in items and their relation to the structure.

3. Description of all loose, cast-in and field hardware.

4. Field installed anchor location drawings.

5. Erection sequences and handling requirements.

6. Elevation view of each member.

7. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, etc.

8. Lifting and erection inserts.
9. Dimensions and finishes.
10. Method of transportation.

C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.10 DELIVERY, STORAGE AND HANDLING

A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

B. Store all units off ground.

C. Place stored units so that identification marks are easily discernible.

D. Separate stacked members by battens across full width of each bearing point.

E. Stack so that lifting devices are accessible and undamaged.

F. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.11 SITE ACCESS

A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

A. Shall be Type I or Type III: ASTM C150.

2.02 AGGREGATES

A. Lightweight aggregates for concrete: ASTM C330.

B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33.

2.03 ADMIXTURES

A. Air-entraining admixtures: ASTM C260.

B. Water reducing, retarding, accelerating admixtures: ASTM C494.

2.04 WATER

A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 REINFORCING STEEL

A. Reinforcing bars and wire fabric: Per Section 03 21 00, Concrete Reinforcement.

B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416.

2.06 GROUT

A. Grout: Per Section 03 61 00 - Mortar and Grout and complying with the following:

1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.
2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 BEARING PADS

A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 WELDED STUDS

A. Shall be in accordance with AWSD 1.1.

2.09 CAULKING

A. Shall be a nonstaining 1-part polymer acrylic base sealant.

2.10 CONCRETE MIXES

A. Precast: The mixture and mixing of concrete shall be in accordance with ACI 304. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi (34.4 MPa)..

2.11 FABRICATION AND MANUFACTURE

A. The fabrication and manufacture of precast products shall comply with the PCI Manual of Practice, and as specified herein.

B. Provide for those openings ten (10) inches (250 mrn) round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast products have been erected. Openings shall be approved by the Engineer before drilling or cutting. No tension reinforcement shall be cut.

C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.

D. The manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.

E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.

F. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 ACCEPTABLE MANUFACTURERS

A. Precast concrete decks shall be as manufactured by Price Brothers Company; Concrete Components, Inc.; Precast/Schokbeton; or equal.

B. Precast concrete steps shall be as manufactured by Unit Step Company; Michigan Precast Concrete; or equal.

PART 3 EXECUTION

3.01 VERIFICATION

A. Examine the substrates and conditions under which the precast concrete is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.

B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.

C. All shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 INSTALLATION - GENERAL

A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by the Contractor. Members shall be lifted by means of

suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 ALIGNMENT

A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Engineer.

3.05 FIELD WELDING

A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 GROUTING AND CAULKING

A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by the Engineer. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.

B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 ATTACHMENTS

A. Subject to the approval of the Engineer, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 FIELD QUALITY CONTROL

A. Final inspection and acceptance of erected precast concrete shall be made by the Engineer to verify conformance with Plans and Specifications.

3.09 SCHEDULES

A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

END OF SECTION

SECTION 03 41 33
PRECAST STRUCTURAL PRETENSIONED CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes precast and precast prestressed structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 03 15 00 - Concrete Accessories

C. Section 03 20 00 - Concrete Reinforcing

D. Section 06 60 00 - 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. AASHTO LRFD: AASHTO LRFD Bridge Design Specifications
2. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
3. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete
4. ASTM A416/A416M: Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete
5. ASTM C33/C33M: Standard Specification for Concrete Aggregates
6. ASTM C150/C150M: Standard Specification for Portland Cement
7. ASTM C260/C260M:
8. ASTM C330/C330M: Standard Specification for Lightweight Aggregates for Structural Concrete
9. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete
10. ASTM C913: Standard Specification for Precast Concrete Water and Wastewater Structures
11. AWS D1.1/D1.1M: Structural Welding Code - Steel
12. PCI MNL-117: Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
13. PCI MNL-120: Design Handbook

1.04 QUALIFICATIONS

A. Manufacturer shall be a company specializing in providing precast and/or precast prestressed concrete products and services normally associated with the industry for at least five (5) years.

1. When requested by Engineer, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.

B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.

C. Welders shall have qualified within the past year in accordance with AWS D1.1/D1.1M.

1.05 DESIGN CRITERIA

A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast, prestressed concrete design.

B. Use in the design applicable codes, ACI 318, or AASHTO LRFD.

C. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.

D. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16 (HS20) loading and installation conditions.

1.06 ALLOWABLE TOLERANCES

A. Design deviations may be permitted only after the Engineer's review of the manufacturer's proposed design supported by complete design calculations and drawings.

B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to the Owner.

C. Length: ±1/8 inch per 10 feet, ±1/4 inch maximum

D. Cross sectional dimensions:

1. Less than 24 inches: ±1/4 inch
2. 24 - 36 inches: ±3/8 inch
3. Over 36 inches 36 inches: ±1/2 inch

E. Thickness: ±1/4 inch

F. Position of anchors and inserts: ±1/2 inch of centerline location shown on the Plans.

G. Horizontal alignment or sweep: 1/4 inch total or 1/8 inch per 10 feet, whichever is greater. Maximum of 1/2 inch gap between two (2) adjacent members due to sweep.

H. End squareness: 3/8 inch maximum

I. Blockouts: ±1/2 inch off centerline locations shown on the Plans.

J. Out of square: 1/8 inch per six (6) feet (5 mm per 3 m) measured on the diagonal.

K. Warpage, after installation: 1/8 inch per 6 feet length, or 3/8 inch, whichever is greater.

L. Vertical alignment:

1. Bottom edges of members from line established at lower face: ±1/4 inch.
2. Bottom surface from straight line between supports: 1/240 of clear span.

1.07 SOURCE QUALITY CONTROL

A. Comply generally with applicable provisions of PCI MNL-117- Manual for Quality Control for Plants and Production of Precast, Prestressed Concrete Products.

1.08 SUBMITTALS

A. Contractor shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of this Section.

B. Submit erection or production drawings showing:

1. drawings and/or elevations locating and defining all material furnished by manufacturer.
2. sections and details showing connections, cast-in items and their relation to the structure.
3. description of all loose, cast-in and field hardware.
4. field installed anchor location drawings.

5. erection sequences and handling requirements.
6. elevation view of each member.
7. sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, etc.
8. lifting and erection inserts.
9. dimensions and finishes.
10. prestress for strand and concrete strengths.
11. estimated cambers.
12. method of transportation.

C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.09 DELIVERY, STORAGE AND HANDLING

A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

1.10 SITE ACCESS

A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

A. Shall be Type I or Type III: ASTM C150/C150M.

2.02 AGGREGATES

A. Lightweight aggregates for concrete: ASTM C330/C330M.

B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33/C33M.

2.03 ADMIXTURES

A. Air-entraining admixtures: ASTM C260/C260M.

B. Water reducing, retarding, accelerating admixtures: ASTM C494/C494M.

2.04 WATER

A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 REINFORCING STEEL

A. Reinforcing bars and wire fabric: Per Section 03 20 00.

B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416/A416M.

2.06 GROUT

A. Grout: Per Section 04 05 11, Mortaring and Grouting and complying with the following:

1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.
2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 BEARING PADS

A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 WELDED STUDS

A. Shall be in accordance with AWS D1.1/D1.1M.

2.09 CAULKING

A. Shall be a nonstaining 1-part polymer acrylic base sealant.

2.10 CONCRETE MIXES

A. Precast, Prestressed:

1. The mixture and mixing of concrete shall be in accordance with ACI 304R. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi. The strength at initial prestress or form release shall be no less than 3,500 psi. Use of calcium chloride, chloride ions or other salts is not permitted.

B. Precast:

1. Shall be the same requirements of precast, prestressed, except the mixture shall produce concrete with the 28-day compressive strength no less than 4,000 psi.

2.11 FABRICATION AND MANUFACTURE

A. The fabrication and manufacture of precast and/or prestressed products shall comply withPCI MNL-117, and as specified herein.

B. Provide for those openings 10 inch round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast prestressed products have been erected. Openings shall be approved by the Engineer before drilling or cutting. No tension reinforcement shall be cut.

C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.

D. Manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.

E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.

F. Strands shall be recessed 1 inch and holes grouted. The ends of the member shall receive a smooth finish.

G. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 ACCEPTABLE MANUFACTURERS

A. Precast concrete decks shall be as manufactured by:

1. Price Brothers Company Price Brothers Company;
2. Concrete Components, Inc.
3. Precast/Schokbeton
4. Approved equal.

B. Precast concrete steps shall be as manufactured by:

1. Unit Step Company
2. Michigan Precast Concrete
3. Approved equal.

PART 3 EXECUTION

3.01 VERIFICATION

A. Examine the substrates and conditions under which the precast concrete is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.

B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.

C. Shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 INSTALLATION - GENERAL

A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by the Contractor. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 ALIGNMENT

A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Engineer.

3.05 FIELD WELDING

A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 GROUTING AND CAULKING

A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by the Engineer. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.

B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 ATTACHMENTS

A. Subject to the approval of the Engineer, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 FIELD QUALITY CONTROL

A. Final inspection and acceptance of erected precast and precast prestressed concrete shall be made by the Engineer to verify conformance with Plans and Specifications.

3.09 SCHEDULES

A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

END OF SECTION

SECTION 03 60 00
GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide grout, complete and in place, in accordance with the Contract Documents

B. The following types of grout are covered in this Section:

1. Cement Grout
2. Non-Shrink Grout - Class I (cement-based)
3. Non-Shrink Grout - Class II (cement-based)
4. Non-Shrink Epoxy Grout
5. Epoxy Anchor Grout for Post Installed Adhesive Anchors
6. Topping Grout and Concrete/Grout Fill

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 318-19 - Building Code Requirements for Structural Concrete
2. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM)

1. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
2. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
3. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
4. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
5. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, grouts, Monolithic Surfacings, and Polymer Concretes
6. ASTM C648 - Standard Test Method for Breaking Strength of Ceramic Tile
7. ASTM C695 - Standard Test Method for Compressive Strength of Carbon and Graphite
8. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
9. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
10. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

11. ASTM C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
12. ASTM C1090 - Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
13. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
14. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete
15. ASTM C1339 - Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.04 SUBMITTALS

A. Furnish the following submittals in accordance with Section 01 33 00:

1. Certified testing lab reports for tests indicated herein.
2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
3. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
4. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.
5. Manufacturer’s certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
6. Submit manufacturer's written warranty as indicated herein.
7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Owner. The specimens will be made by the Owner or its representative.
2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107 at intervals during construction selected by the Owner. As a minimum, a set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 30 00, at intervals during construction selected by the Owner.
4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579 at intervals during construction selected by the Owner. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
5. The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.

6. Contractor shall assist the Owner in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 30 00, unless indicated otherwise.

C. Pre-Installation Demonstration and Training:

1. Cement and Epoxy-Based Non-Shrink Grouts:

a. The grout manufacturer shall give a demonstration and training session for the cement based non-shrink and epoxy grouts to be used on the project, before any installation of grout is allowed.

b. Training session shall use a minimum of 5 bags of cement-based non-shrink class I grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining grout shall be placed, and curing may be initiated on actual project placements such as baseplates and tie holes to provide on-the-job training for the Contractor and Owner. Contractor employees who will be doing the grouting shall participate in this training and demonstration session. The training session shall include methods for curing the grout.

c. The manufacturer shall mix enough cement-based non-shrink class II grout for a minimum of 15 tie holes and shall train the Contractor’s employees in how to perform the Work and cure the grout. Contractor shall have the employees assisting in the mixing and sealing of the tie holes.

d. If the project includes patching, through bolt holes, epoxy anchors, and/or blockouts, the manufacturer shall also train the Contractor’s employees in the mixing and curing of the epoxy grouts for each of these applications.

e. The Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the Owner.

2. Epoxy Anchor Grout for Adhesive Anchors:

a. Special inspection for all adhesive anchor installations shall be provided:

1) As recommended or required by the ICC-ES or IAPMO-UES report.

2) As required by the enforceable building code.

3) As otherwise indicated in the Contract Documents.

4) The most stringent of the above requirements shall be used. The cost of special inspection of adhesive anchors shall be paid for by the Owner.

b. Before installing adhesive anchors in the Work, adhesive anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

c. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading/torquing.

1) Anchors installed in both the vertical and horizontal positions in a mock-up concrete panel of adequate size and thickness. Anchors shall be tested in tension. A minimum of 3 anchors shall be tested for each installation position.

2) Anchors shall be tested at 2 times the published allowable tension load or 1-1/4 times the maximum design strength of the anchors in tension as indicated in the ICC-ES or IAPMO-UES report. The test load need not exceed 80 percent of the

nominal yield strength of the anchor, based on steel strength, as determined by ACI 318-19 Chapter 17.

3) If any of the 3 test bolts in any installation position fail to reach the test loads, the installer shall be re-tested with the same procedure. Re-testing is required only for the failed installation position.

4) An installer who has 3 consecutive successful bolt tests in the first or second trial is considered qualified for adhesive anchor installation for this project. The manufacturer's representative shall issue a certificate to the qualified installer, and a copy of the certificate shall be filed with the Contractor and be submitted to the Owner.

5) The test anchor size shall be the largest size adhesive anchor used on the project. The anchor embedment length and edge distances shall be adequate to resist the test loads listed above.

6) Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

7) The certification of each qualified installer shall be available for verification at the Special Inspector's request.

8) Defective anchors noted by the Special Inspector shall be replaced and re-installed by the Contractor without any additional compensation.

1.06 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty:

1. Furnish one-year warranty for Work provided under this Section.

a. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Application:

1. Unless indicated otherwise, grouts shall be provided as listed in below whether indicated on the Drawings or not.

Application	Type of Grout
Anchor bolts, anchor rods, and reinforcing steel required to be set in grout	Epoxy Anchor Grout
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements	Non-Shrink - Class II
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout
Toppings and concrete/grout fill greater than 3-inches thick	Structural Concrete per 03 31 00
Surface repairs unless indicated otherwise	Cement Grout
Surface repairs less than 4" in their least dimension	Non-Shrink Epoxy
Repair holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I

Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II
Any application not listed above, where grout is indicated	Non-Shrink - Class I, unless specifically indicated otherwise

B. Cement Grout:

1. Cement grout shall be composed of one part of cement, 3 parts of sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland Cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4,000 psi.

2. Cement grout materials shall be as indicated in Section 03 30 00.

C. Non-Shrink Grouts (Cement-Based):

1. General:

a. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

b. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.

c. Grout shall not contain chlorides or additives that may contribute to corrosion.

d. Grout shall be formulated to be used at any consistency from fluid to plastic.

e. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:

1) Minimum tensile splitting strength of 500 psi per ASTM C496.

2) Minimum flexural strength of 1,000 psi per ASTM C580.

3) Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C882.

2. Non-Shrink Grout – Class I:

a. Non-Shrink Grout – Class I shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.

b. Non-Shrink Grout – Class I shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.

c. Non-Shrink Grout – Class I shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. The grout when tested shall not bleed or segregate at maximum allowed water.

d. Non-Shrink Grout – Class I shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

e. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.

f. Non-Shrink Grout – Class I shall be Masterflow 713 Plus by BASF, Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, Duragrout by L&M Construction Chemicals; High-Flow Grout by Euclid Chemical Company, CG 200 PC by Hilti, or approved equal.

3. Non-Shrink Grout – Class II:

    a. Non-Shrink Grout – Class II shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.

    b. Non-Shrink Grout – Class II shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827.

    c. Non-Shrink Grout – Class II shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

    d. Non-Shrink Grout – Class II shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 107.

    e. Non-Shrink Grout – Class II shall meet the requirements of ASTM C1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.

    f. The grout when tested shall not bleed or segregate at maximum allowed water content.

    g. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.

    h. Non-Shrink Grout – Class II shall be Masterflow 928 by BASF, Five Star Fluid Grout 100 by Five Star Products, SikaGrout 212 by Sika Group, Crystex by L&M Construction Chemicals, or approved equal.

D. Non-Shrink Epoxy Grout:

1. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

2. Epoxy grout shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827, (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).

3. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C531.

4. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, Method B.

5. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.

6. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C1339 for bearing area and flow.

7. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

8. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
    a. Minimum bond strength to concrete of 3,000 psi per ASTM C882 modified.
    b. Minimum bond strength to steel of 1,700 psi per ASTM C882 modified.
    c. Minimum flexural strength of 2,500 psi per ASTM C580.
    d. Minimum tensile strength of 2,000 psi per ASTM C307.
9. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Masterflow 648 CP Plus by BASF, Sikadur 42 Grout-Pak by Sika Corporation, or approved equal.
10. Epoxy Anchor Grout
11. Epoxy anchor grout for use in concrete shall be certified for use in accordance with ICC-ES AC 308.
12. Epoxy anchor grout shall conform to ASTM C881, Type IV, Class B & C, Grade 3 with the exception of gel time.
13. Heat deflection temperature per ASTM D648 shall be a minimum 120 degrees F.
14. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short-term temperature of 110 degrees F and 50 percent of its capacity up to a short-term temperature of 150 degrees F.
15. Grout shall come in a two (2) chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
16. Epoxy anchor grout shall be capable of being used in submerged applications once cured.
17. Compressive strength per ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics shall be 10,000 psi minimum.
18. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.
19. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents. Embedment shall not exceed 67 percent of the member depth.
20. Epoxy anchor grout shall be PE1000+ by Powers Fasteners; HIT-RE 500-V3 by Hilti, SET-XP by Simpson Strong-Tie, or approved equal.

E. Topping Grout and Concrete/Grout Fill:
1. Where fill thickness is 3-inches or greater, structural concrete, as indicated in Section 03 30 00, shall be used. Omit the coarse aggregate in topping grout used in clarifiers.
2. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 30 00, shall apply unless indicated otherwise.
3. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.

4. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 inch	100
3/8 inch	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

5. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00, except that drying shrinkage tests are not required.

6. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00.

7. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 5,000 psi.

8. Topping grout used in clarifiers or where the fill thickness is 3 inches or greater shall contain synthetic fiber reinforcing, unless otherwise shown on the Contract Documents. Synthetic fiber reinforcing shall be in accordance with Section 03 30 00 and shall conform to ASTM C1116, Type III.

F. Curing Materials:

1. Curing materials shall be in accordance with Section 03 30 00, and as recommended by the manufacturer of prepackaged grouts.

G. Consistency:

1. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

2. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

H. Measurement of Ingredients:

1. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.

2. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Owner.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 GROUTING PROCEDURES

A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Owner, alternate grouting methods shall be submitted by the Contractor for acceptance by the Owner.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Drilled Anchors and Reinforcing Bars:

1. General:

a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions and applicable ICC-ES or IAPMO-UES report requirements. Holes shall be drilled, brushed and cleaned in accordance with the manufacturer’s instructions. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has cured for the full cure time indicated by the manufacturer and reached its indicated strength in accordance with the manufacturer's instructions.

b. Contractor shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the Owner if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

c. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.

d. Core drilling of holes is not allowed.

e. Relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the Work and shall be provided at no additional cost to the Owner.

f. Abandoned drilled holes shall be filled with Epoxy Anchor Grout.

2. Epoxy Adhesive Anchors:

a. Grout shall be proportioned and mixed per the manufacturer's instructions.

b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.

c. Holes shall be dry.

3. Cement Based Non-Shrink Grout used for Anchorage:

a. In places of high temperature or fire hazard, anchor bolts and anchor rods shall be grouted in using cement based non-shrink grout, Class I.

b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor bolt, anchor rod or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.

c. When the anchor bolt or anchor rod diameter is one-inch or less, the hole diameter shall be a minimum of 2-inches. When the anchor bolt/rod diameter is greater than one-inch, the hole diameter shall be at least twice the anchor bolt/rod diameter.

d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.

4. The non-shrink grout shall be placed in the holes in a non-sag (trowelable) consistency. The grout shall be placed in the holes before the anchor bolt/rod and then the anchor bolt/rod inserted and vibrated to ensure proper coverage.

D. Topping Grout and Concrete/Grout Fill:

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the Owner, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) - Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The

topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Owner, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.03 CONSOLIDATION

A. Grout shall be placed in such a manner that the space to be grouted is completely filled.

3.04 CURING

A. Cement-based grouts shall be cured per Section 03 30 00 and per the manufacturer's recommendations.

END OF SECTION

SECTION 04 05 11
MORTARING AND GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Mortar and grout for masonry.

1.02 RELATED SECTIONS

A. Section 01 45 00 - Quality Control

B. Section 04 20 00 - Unit Masonry

C. Section 05 50 00 - Metal Fabrications

D. Section 08 11 50 - Custom Steel Doors

E. Section 08 12 13 - Custom Steel Frames

1.03 REFERENCE STANDARDS

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 33 00 - 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 60 00 - 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 F (32 degrees C) 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 the Engineer.

B. It is not the intent of the 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 04300 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 F (32 degrees C), or two-and-one-half hours at temperatures under 50 degrees F (10 degrees C).

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 TEXTS

A. Test mortar and grout in accordance with Section 01 45 00 - 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.

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 off site 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 “mismatch.”

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 05 13
MASONRY MORTARING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish tools, equipment, materials, and supplies and shall perform labor required to complete the mortar for unit masonry construction and masonry repointing work as indicated on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04 05 11 - Mortaring and Grouting

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

B. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

C. ASTM C150/C150M - Standard Specification for Portland Cement

D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes

E. ASTM C270 - Standard Specification for Mortar for Unit Masonry

F. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's instructions, product data and MSDS.

2. Submit mortar mix design as well as data indicating proportion or property specifications used for each type of mortar including Portland cement, lime sand and coloring admixtures, if any.

B. Samples:

1. Submit cured samples of colored mortar to Architect for initial review.

C. Manufacturer's Certificate:

1. Certify that products meet or exceed specified requirements.

D. Test Reports:

1. Submit test reports for mortar indicating conformance with ASTM C270 property specifications.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver prepackaged, dry-blended mortar mix to project site in clearly labeled plastic-lined bags each bearing the name and address of the manufacturer, Production Codes or Batch Numbers, and color or formula numbers. Individual bag weight is approximately 50 pounds.

B. Store mortar off the ground and in accordance with manufacturer's instructions to prevent contamination by foreign materials. Maintain packaged materials in a clean, dry state protected against weather, traffic and foreign materials.

1.06 QUALITY ASSURANCE

A. Cementitious materials, aggregates and color admixtures are to be blended and packaged under factory-controlled conditions, requiring only the addition of water on site.

B. Use approved mix designs and single source all aggregates, cement, lime and color admixtures to assure maximum consistency.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements:

B. When ambient air temperature is below 40 degrees Fahrenheit, heat mixing water to maintain mortar temperature between 40- and 120-degrees Fahrenheit until placed. If necessary, store materials in a heated area to allow mortar temperatures to remain above 40 degrees Fahrenheit throughout the placement and finishing cycle.

1. Subject to written approval of the mortar manufacturer, and in accordance with their written dosage instructions, add the recommended quantity and type of non-chloride accelerating admixture when temperatures are below 32 degrees Fahrenheit.

C. Hot Weather Requirements:

1. Under hot, dry and windy conditions use proper pre-dampening, protection and moist curing procedures as required to keep mortar moist for 72 hours following final tooling.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement: ASTM C150/C150M Type I, grey or white as required to match original mortar. Fly ash, slag and pozzolans are not permitted as substitutes for Portland cement.

B. Hydrated Lime: ASTM C207 Type S, incorporated as a finely divided powder in uniform particle size, free of lumps, flakes or other inconsistencies.

C. Mortar Aggregate: ASTM C144 Natural sand blend, rounded to sub-angular in shape, washed, screened and dried, with zero or near zero -270 crystalline silica content. Aggregate to be selected to match the color and texture of the original mortar aggregates as closely as possible while remaining in compliance with ASTM C144 grading and soundness requirements.

D. Mortar Colors: Inorganic mineral oxides meeting the requirements of ASTM C797, at levels not to exceed 10% on cement weight, except for carbon black, which may not exceed 2% on cement weight.

E. Admixtures: No admixtures shall be used without the express written consent of the Architect and the mortar manufacturer. Calcium chloride is not permitted in any mortar. Admixtures containing more than 0.1% chloride ions are not permitted.

F. Water: Potable, free of deleterious quantities of materials which may affect mortar performance or appearance.

2.02 MIXING MORTAR

A. Mortar shall be preblended, pre-colored and prepackaged under controlled factory conditions. Ingredients are to be batched within plus or minus 1% accuracy, except pigments which shall be weighed to a precision of 0.01%.

1. Mortar shall conform to the minimum property requirements given in Table II of ASTM C270, based on 28-day laboratory testing only. Mortar type shall be as selected, based on the following criteria:

a. Type M: 2500 psi min.; for pavements and walls in contact with earth or below grade.

b. Type S: 1800 psi min.; for chimneys, parapets and load-bearing masonry constructions.

c. Type N: 750 psi min.; for general repointing of walls

d. Type O: 350 psi min.; for repointing of softer masonry or masonry where original mortar design mix was Type O.

e. Type K: High lime mortar; for repointing of historic masonry or structures constructed with low strength brick or sandstone.

f. Straight lime Mortar "L": No Portland cement in mix; for masonry buildings constructed prior to 1900 and incorporating lime mortars without Portland cement.

2. Thoroughly mix mortar in quantities needed for immediate use, using mechanical mortar mixer or paddle mixer. Add approximately half the required water and mix mortar for a minimum of 5 minutes, and then slowly add water as needed to reach the desired working consistency. Do not exceed mix time of 10 minutes.

3. Add only clean, potable water at the project site. Do not add cement, lime, bonding agents, coloring admixtures, set accelerators, plasticizers, air entraining admixtures or other materials unless specifically authorized in writing.

4. Use a batch type mixer in accordance with ASTM C270.

5. Use of ready-mix mortar (ASTM C1142) is not acceptable.

6. Use mortar within 1-1/2 hours of mixing, after which unused mortar is to be discarded. This period shall be reduced to 30 minutes in hot weather.

a. Retempering is allowed in accordance with ASTM C270 if it is demonstrated that retempering does not negatively affect color consistency.

b. Retempering is to be used to replace water lost to evaporation only.

c. Do not retemper mortars which have begun to set.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pre-dampen masonry surfaces to receive repointing mortar for a minimum of 20 minutes prior to mortar placement.

B. Masonry surfaces should be saturated but free of excess or standing water at time of mortar placement.

C. Fill mortar into joints in 1/4 inch "lifts". Start by filling deeper sections, compacting each layer, packing it into the rear and corners of the joint.

D. As soon as the mortar reaches "thumbprint" hardness, apply the next layer at 1/4 inch thickness. A minimum of 2 layers are required.

E. When final layer is thumbprint hard, tool to specified profile. Match to adjacent, existing profile or to original profile as instructed.

F. To avoid changing the appearance of the building, it may be necessary to slightly recess the mortar from the masonry surface. Do not flush fill joints in worn masonry if this results in a visually wider joint than the original.

G. Remove excess mortar and smears using a stiff natural bristle brush and clean water before it has set.

H. Wet cure tooled joints as required by lightly misting with clean water periodically for up to 3 days following installation.

1. Type K and straight Lime mortars always require 3 days wet cure.

2. Types O and N may require shorter wet cure periods, depending on temperature, humidity, wind and suction of the masonry.

a. Misting should be performed every hour or two on the first day, as required to maintain the mortar in a wet condition, and this may be reduced to every three or four hours on subsequent days.

I. Final Cleaning:

1. Allow mortar to fully cure for a minimum of 28 days before final cleaning. Only low pressure should be used to avoid damaging newly repointed joints.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete masonry units (CMU).

B. Reinforcement, anchorage, and accessories.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 04 05 11 - Mortaring and Grouting

B. Section 04 05 13 - Masonry Mortaring

C. Section 05 50 00 - Metal Fabrications

D. Section 07 62 00 - Sheet Metal Flashing And Trim

E. Section 07 92 00 - Joint Sealants

F. Section 08 11 50 - Custom Steel Doors

G. Section 08 12 13 - Hollow Metal Frames

1.03 REFERENCE STANDARDS

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 B370 - Copper Sheet and Strip for Building Construction.

K. ASTM C55 - Concrete Building Brick.

L. ASTM C62 - Building Brick (Solid Masonry Units Made From Clay or Shale).

M. ASTM C90 - Load-Bearing Concrete Masonry Units.

N. ASTM C126 - Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.

O. ASTM C129 - Non-Load Bearing Concrete Masonry Units.

P. ASTM C216 - Facing Brick (Solid Masonry Units Made From Clay or Shale).

Q. ASTM C652 - Hollow Brick (Hollow Masonry Units Made From Clay or Shale).

R. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

S. UL - Fire Resistance Directory.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - 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 block 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 MOCKUP

A. Provide mockup of composite masonry under provisions of Section 01 45 00 - Quality Control.

B. Construct a masonry wall into a panel sized 9 feet (3 m) long by 3 feet (1 m) high, which includes mortar and accessories, wall openings, flashings, wall insulation, air barrier, vapor barrier, etc.

C. Locate as directed by the Engineer.

D. Mockup may, at the Engineers discretion, remain as part of the Work.

1.08 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section, under provisions of Section 01 31 19 - Project Meetings.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 - Product Requirements.

1.10 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 F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

1.11 COORDINATION

A. Coordinate work under provisions of Section 01 31 19 - Project Meetings.

B. Coordinate the masonry work with installation of door frames and window anchors.

PART 2 PRODUCTS

2.01 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. Color for integrally colored units used in the building(s) shall be synthetic iron oxide, dry granulated pigments. Color shall be selected by the Owner from the manufacturers complete color palette. For the basis of bidding the Contractor pricing shall include Fendt “85% Maize, 5% Pearl, 10% Yucatan @ 1lb per 100 lbs White cement/Slag” or equivalent.

C. Hollow Load Bearing Block Units (CMU): medium weight, ASTM C-90.

D. Solid Load-Bearing Block Units (CMU): medium weight, ASTM C-90.

E. Integrally Colored Split Faced Size and Shape: Nominal modular size of 8 x 16 x 8 thickness shown having a split face on one side of masonry block. Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.

F. Standard Block Size and Shape: Nominal modular size of 8 x 16 x 8 thickness shown having a smooth face. Provide special units for 90 degree corners, bond beams, lintels, and bullnosed corners.

G. CMU Admixture System For Single Wythe CMU Exterior Walls:

1. Admixture shall consist of two polymeric admixtures.
2. One, covered by this short-form specification, is mixed throughout the low slump concrete during manufacture of the CMU by a Qualified CMU manufacturer.
3. The second admixture is added to the mortar on site, during mixing, by the mason.
4. Both admixtures are necessary to achieve a water-repellent single wythe CMU wall.
5. This admixture combination is only required for exterior single wythe CMU walls exposed to the weather.
6. Admixtures shall be as manufactured by Krete Industries, W.R. Grace Chemicals or other approved.

2.02 CMU INSULATION SYSTEM

A. All CMU shall be insulated, 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 minimum.
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.

2.03 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. Hohmann & Barnard, Inc.

b. Wire-Bond

c. Or other Engineer approved equal.

B. Prefabricated tees and corner pieces matching truss reinforcement.

C. 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 approved equal.

2.04 MORTAR AND GROUT

A. Mortar and Grout: As specified in Section 04 05 11 - Mortaring and Grouting.

2.05 FLASHINGS

A. Base Flashing At Single Wythe Exterior Walls:

1. BlockFlash" pan flashing with adjoining bridge, integral weeps (with bug guards) and drainage mats manufactured by Mortar Net Solutions.

2. Install at wall base above grouted core row and above wall opening lintels.

B. 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. W.R. Grace & Co., Construction Products Division, Perm-A-Barrier Wall Flashing.

2. Hohmann & Barnard, Inc., Textroflash.

3. Williams Products, Inc., Everlastic MF-40.

C. Asphalt Mastic: Asphalt based cement used as a bonding agent for bonding asphalt coated flashings to all construction surfaces.

1. Hohmann and Barnard "Asphalt Mastic".

2.06 ACCESSORIES

A. Joint Filler (Backer Rod): Refer to Specification Section 07 92 00 - Joint Sealants.

B. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

C. 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.

D. Control Joint Filler: unless otherwise noted on the drawings, provide 3/8" thick, 3" wide, closed cell neoprene strip gasket. Use two 3" strips at CMU wall, for installed width of 6".

E. 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.

B. Verify that foundations are within tolerances specified.

1. Verify that reinforcing dowels are properly placed.

2. 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.

C. Foundation and steel frame discrepancies:

1. Notify the Architect 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 the 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 the Owner's Representative without Owner's extra cost.

D. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

E. 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.

F. Verify items provided by other sections of work are properly sized and located.

G. 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. 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.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. 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.

D. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

E. All 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. 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.

B. Start the partitions on concrete floor slabs and extend to roof or floor construction above; except that where partitions are shown to terminate at suspended ceilings, extend partitions a minimum of 4 inches above such suspended ceilings, unless shown otherwise.

C. 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.

D. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

E. Remove excess mortar as work progresses.

F. 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. All precautions shall be taken to avoid staining of the finished surface of the masonry units.

G. Interlock intersections and external corners. The intersection of all walls shall be toothed together with the intersecting wall.

H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

J. 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.

K. 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.

L. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

M. 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.

N. Fill the spaces between metal frames and masonry with grout.

O. Use cores filled with mortar, or provide solid units for anchorage in locations where handrails, plumbing fixtures, utility cabinets and similar items are attached.

P. 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 the Owner's Representative before proceeding.

Q. Masonry work that shows evidence of having been frozen shall be removed and replaced with new materials.

R. 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.

S. Wet or frozen masonry units shall not be used until they are allowed to dry.

T. All 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 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 pre-fabricated 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.

3.06 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.

3.07 LINTELS AND BOND BEAMSLINTELS

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.

3.08 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.

3.09 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 07900 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.

3.10 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.

3.11 CMU INSULATION INSTALLATION

A. Handle and store products in accordance with manufacturer’s published recommendations.

B. Drill the 5/8” 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 the 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 the Engineer to verify complete filling of the masonry wall cores.

3. If deficiencies are found, additional holes shall be drilled until the 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.

3.12 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.

3.13 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.

3.14 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 45 00 - Quality Control.

B. Field Inspections / Quality Assurance.

C. Special masonry inspections shall be required for engineered masonry that is part of non-essential buildings as defined MBC Section 1705.4.

D. Refer to Structural drawings for additional requirements and criteria.

E. Seismic resistance testing shall be in accordance with MBC Section 1705.13.

3.15 CLEANING

A. Clean work under provisions of Section 01 77 00 - Closeout Procedures.

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 the Engineer prior to starting the work.

a. The 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 the Owner and the 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.

3.16 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00 - Temporary Facilities and Controls.

B. All 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 the 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 the Owner, the Contractor shall clean the walls again, in accordance with the above specified procedures, to make them acceptable.

END OF SECTION

SECTION 04 23 00
GLASS UNIT MASONRY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Glass masonry units.

B. Mortar bed and pointing sealant.

C. Perimeter treatment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04 05 11 - Mortaring And Grouting

B. Section 04 05 13 - Masonry Mortaring

C. Section 04 20 00 - Unit Masonry

D. Section 07 92 00 - Joint Sealants

1.03 REFERENCE STANDARDS

A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2001.

B. ASTM A123 - Zinc (Hot-Galvanized) Coatings of Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

C. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2001a.

D. ASTM C270 - Mortar for Unit Masonry.

E. ASTM C780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

F. ASTM D 1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Re-approved 2002).

G. ASTM D 1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 1995 (Re-approved 2000).

H. ASTM E 119 - Fire Tests of Building Construction and Materials.

I. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

J. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide data for glass units and accessories.

C. Samples:

1. Submit two glass units illustrating size variations, color, design, and face pattern.

2. Submit representative samples of panel reinforcing, panel anchors, expansion strips and sealant as required by the project.

D. Submit documentation verifying that glass block units are classified for a 3/4 hour fire exposure according to ASTM E163 or UL 9 Fire Test of Window Assemblies. All such glass block units shall carry the appropriate UL Labels.

E. Manufacturer's Installation Instructions: Indicate special procedures, positioning of reinforcement, perimeter conditions requiring special attention, and any other special instructions.

1.05 QUALIFICATIONS

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

B. Installer: Company specializing in performing the work of this section with minimum three years experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

B. Store products in manufacturer’s unopened packaging in a clean, cool, dry area until ready for installation.

C. Protect opened cartons of glass block against wind blown rain or water runoff with tarpaulins or plastic coverings.

D. Accept glass units on site on pallets; inspect for damage.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install glass block when temperatures is 40 degrees Fahrenheit (4 degrees Celsius) and falling.

B. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

C. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.08 FIELD MEASUREMENTS

A. Verify that field measurements on shop drawings.

1.09 EXTRA MATERIALS

A. Provide ten of each type and size of glass unit.

PART 2 PRODUCTS

2.01 MANUFACTURERS - GLASS UNITS

A. Seves Glass Block

B. Substitutions: Under provisions of Section 00 63 25 - Substitution Request Form.

2.02 GLASS UNITS

A. Hollow Glass Units shall be partially evacuated units made of clear glass.

1. Nominal Size: 7-3/4 x 7-3/4 x 3-7/8 inches. Also available 12x12, 6x8, 6x6 and 4x8)
2. Color: Clear, colorless glass.
3. Pattern and Design: 4” Premier Series, Nubio (patterned) or Clarity (clear).
4. Insulation Value: R value of 1.89 BTU/sq ft/h/degree F.
5. Visible Light Transmittance: 75 or 91 percent.
6. Shading Coefficient: 65.
7. Sound Transmission, STC: 39.

8. Fire Rating: 45 Minutes. (maximum 120 sq. ft. opening)
9. Edge: with polyvinyl butyral coating

2.03 ACCESSORIES

A. Panel Reinforcement: Shall be Stainless Steel:
   1. Side Rods: Two 9 gage (4 mm) rods spaced 2 inches (50 mm) apart.
   2. Cross Rods: 14 gage (1.8 mm) rods welded 8 inches (200 mm) oc.

B. Expansion Strips: Dense glass fiber matting, 7/16 x 4 inches (11 x 100 mm) nominal size.

C. Perimeter Channel: Stainless Steel channel and angles, size, as detailed on the drawings, one piece per edge length installed.

D. Asphalt Emulsion: Water based, similar to Karnac Chemical Corp., Karnac 100.

E. Backing Rods: polyethylene foam, neoprene, fibrous glass, or equal as approved by the sealant manufacturer.

2.04 MORTAR AND POINTING MATERIAL

A. Mortar: Type S in accordance with ASTM C270. Mortar shall be 1/2 part Portland Cement, 1/2 part lime, and sand equal to 2 1/4 to 3 times the amount of cementitious material (cement plus lime), all measured by volume.
   1. Portland Cement: Type 1 in accordance with ASTM C150.
   2. Lime: Type S in accordance with ASTM C207. Shall be a high calcium lime, or a pressure hydrated dolomitic lime, provided that not less than 92% of all active ingredients are hydrated.
   3. Sand: A clean white quartzite or silica type, essentially free of iron compounds, for thin joints, in accordance with ASTM C144, not less than 100% passing a No. 8 sieve.

B. Pointing Sealant: Shall be as specified in Section 07900.

2.05 MORTAR MIXING

A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.

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 90 degrees F (32 degrees C), or two-and-one-half hours at temperatures under 50 degrees F (10 degrees C).

2.06 MIX TESTS

A. Testing of Mortar Mix: In accordance with ASTM C270.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive work.

B. Field Measure openings to verify size.

3.02 PREPARATION

A. Clean glass units of substances that may impair bond with mortar or sealant.

B. Establish and protect lines, levels, and coursing.

C. Protect elements surrounding the work of this section from damage and disfigurement.

3.03 INSTALLATION

A. Erect glass units and accessories in accordance with manufacturer's printed instructions.

B. Verify that the channels have been provided at the head and jambs for the purpose of providing panel support within the opening.

C. Mix all mortar components to a consistency that is drier than mortar for ordinary masonry construction. Retempering of the mortar after it has taken its initial set shall not be permitted. DO NOT USE ANY ANTI-FREEZE COMPOUNDS OR ACCELERATORS.

D. Cover sill surface under units with heavy asphalt emulsion as a bond breaker and allow to dry at least 2 hours before first mortar bed is placed.

E. Adhere expansion strips to the jamb and head. Verify that the expansion strips extend the full length of the joint.

F. Set a full bed of mortar applied to the sill.

G. Set the lower course of block. Allow a uniform joint width of 1/4". All mortar joints must be full and not furrowed. Do not use steel tools to tap glass block into position. Do not re-align, tap or otherwise move block after initial placement.

H. Place panel reinforcement at every second horizontal joint (16" o.c.) in full mortar bed and at first course above and below openings within the glass unit panel.

I. Run reinforcing continuous for panel width. Lap reinforcement joints 6 inches (150 mm). Discontinue reinforcement at expansion joints.

J. Isolate panel from adjacent construction on sides and top with expansion strips concealed within perimeter trim. Keep expansion joint voids clear of mortar.

K. Strike joints smooth while mortar is still plastic and before final set. Remove surplus mortar from the faces of glass block and wipe dry. Tool joints smooth and concave before mortar takes final set. At this time remove and clean out all excess mortar from jamb, head and other locations.

L. After mortar has taken final set (approximately 24 hours), install packing tightly between glass block panels and jamb and head construction. Leave space for sealant.

M. Place sealant in mortar joints in accordance with Section 07900. Install sealant evenly to a full depth of recesses as indicated on the Drawings and in accordance with the manufacturer's application manual and instructions.

N. All glass block panels shall be well sealed to prevent water entry.

3.04 TOLERANCES

A. Variation From Joint Width: Plus or minus 1/16 inch (1.6 mm) and minus 0 inches (0 mm).

B. Maximum Variation from Plane of Unit to Adjacent Unit: 1/32 inch (0.8 mm).

C. Maximum Variation of Panel from Plane: 1/16 inch (1.6 mm).

3.05 CLEANING

A. Manufacturers recommendations for cleaning the units shall be followed.

B. Do not scratch or deface units.

C. Remove surplus mortar from the glass units at the time the joints are struck or tooled. Mortar should be removed while it is still plastic using a clean, wet, sponge.

D. Do not use harsh cleaners or acids (of any strength), abrasives or alkaline materials when cleaning the glass block. Do not use a wire brush to remove mortar from the face of the glass block.

E. Final cleaning of the glass block must be done after they are completely installed. Wait until the panels are not in direct sunlight. Start at the top of the panel and flush with large amounts of clean water. Dry all water from the glass block surface. Change cloth frequently to eliminate dried mortar or small aggregate that could scratch the block.

3.06 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00 - Temporary Facilities and Controls.

B. Maintain temperature of glass unit masonry above 40 degrees Fahrenheit (4 degrees Celsius) for the first 48 hours after construction

C. Maintain protective boards at exposed external corners. Provide protection without damaging completed work.

D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The extent of structural steel work is indicated on the Plans, 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 30 00 - Cast-in-Place Concrete

B. Section 04 05 11 - Mortaring and Grouting

C. Section 05 50 00 - Metal Fabrications

D. Section 05 53 00 - Gratings

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 A6/A6M: Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
2. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A194/A194M: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
4. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A500/A500M: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
6. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
7. ASTM A572/A572M: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
8. ASTM A992/A992M: Standard Specification for Structural Steel Shapes
9. ASTM E164: Standard Practice for Contact Ultrasonic Testing of Weldments
10. ASTM F436/F436M: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
11. ASTM C1107/C1107M: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
12. ASTM F3125/F3125M: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
13. SSPC-SP 2: Steel Structures Painting Council, "Hand Tool Cleaning"
14. SSPC-SP 3: Steel Structures Painting Council, "Power Tool Cleaning

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. RCSC (HSBOLT) - "Specification for Structural Joints Using High-Strength Bolts," approved by the Research Council on Structural Connections (RCSC) with the participation of AISC.
4. AWS D1.1/D1.1M - "Structural Welding Code."
5. ASTM A6/A6M - "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 B2.1/B2.1M “Specification for Welding Procedure and Performance Qualification."

B. Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months.

C. If recertification of welders is required, retesting will be the Contractor's responsibility.

1.06 DESIGN OF MEMBERS AND CONNECTIONS

A. Details indicated on the Plans 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 the 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.
2. Members without ends milled for contact bearing which are framed to other members:
    a. 30 feet or less in length ±1/16 inch.
    b. Over 30 feet in length ±1/8 inch.

B. Straightness:

1. Structural members may vary from straightness within the tolerances allowed for wide flange shapes by ASTM A6/A6M, 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 the 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 of Michigan, 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 the 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 in Part 3 of this Section.

PART 2 PRODUCTS

2.01 STRUCTURAL STEEL

A. Rolled Steel Wide Flange and Tee Shapes: ASTM A992/A992M.

B. Other Rolled Steel Plates, Shapes, and Bars: ASTM A572/A572M, G50, unless otherwise indicated on the plans.

C. Hollow Structural Sections: ASTM A500/A500M, Gr B.

D. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.

E. Anchor Bolts:ASTM A307, nonheaded type unless otherwise indicated on the Plans.

2.02 WASHERS, BOLTS, AND NUTS

A. Washers: ASTM F436/F436M

B. Bolts and Nuts:

1. Standard: ASTM A307, Grade A , with nuts conforming to ASTM A563/A563M, Grade A.

2. High Strength: ASTM F3125/F3125M, Grade A325, Type 1, with heavy hex nuts conforming to ASTM A563/A563M, Grade DH.

3. Alloy Steel: ASTM F3125/F3125M, Grade A490, Type 1, with ASTM A194/A194M heavy hex nuts.

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

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C1107/C1107M.

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 Plans.

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 Plans.

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 Plans.

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 RCSC (HSBOLT).

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 Plans and/or final shop drawings. Provide threaded nuts welded to framing, and other specialty items as indicated on the Plans, and/or final shop drawings to receive other work.

B. 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 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 SSPC-SP 2 and SSPC-SP 3.

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 mils. 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 and erector must examine the areas and conditions under which structural steel work is to be installed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Contractor and erector.

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. If the construction in place is not inspected by the Contractor prior to erection, the 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 inch 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. Clean the bottom surface of base and bearing plates.

B. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

C. 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.

D. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. 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. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

B. Level and plumb individual members of the structure as specified in Part 1 of this Section unless otherwise specified by AISC tolerances.

C. 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.

D. Splice members only where indicated on the Plans and/or final shop drawings.

E. Erection bolts on exposed welded construction, shall be removed and holes filled with plug welds and ground smooth at exposed surfaces.

F. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

G. 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.

H. 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 the 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 mils.

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 the requirements of the current building code at the place of the Work.

2. The 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. The testing agency may inspect structural steel at the plant before shipment; however, the Engineer reserves the right, at any time before final acceptance 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 as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work will be at the Contractor's expense.

6. Work determined to be defective by the Engineer and/or local agencies regardless of all previous inspections, shall be corrected to the satisfaction of the Engineer at no extra cost to the 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.

2. 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.

3. Inspection of field bolted connections will be in accordance with AISC Specifications.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes gratings, railings, floor hatches, lintels, stair nosings, ladders, guard posts, and other miscellaneous items of metal. Not included in this Section are prefabricated metal stairways.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 15 00 - Concrete Accessories

B. Section 03 30 00 - Cast-in-Place Concrete

C. Section 05 12 00 - 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. ASTM A36/A36M: Standard Specification for Carbon Structural Steel
2. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A153/A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A240/A240M: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
6. ASTM A276/A276M: Standard Specification for Stainless Steel Bars and Shapes
7. ASTM A500/A500M: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
8. ASTM A501/A501M: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
9. ASTM B209/B209M: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
10. ASTM B221: Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
11. ASTM B429/B429M: Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
12. AISC 303: Code of Standard Practice for Steel Buildings and Bridges
13. AWS D1.1/D1.1M: Structural Welding Code - Steel
14. Federal Specifications (FS)
15. Occupational Safety and Health Act (OSHA)

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. applied at any point in any direction.

2. Uniform load of 50 lbs./lft applied to the top rail horizontally with a simultaneous load of 100 lbs/lft 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. applied at any point.

2. Uniform load of 50 lbs./lft 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 lbf on an area not to exceed 1 sft 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 / sft of horizontal surface.

2. Maximum allowable deflection is 1/4 inch with 150 lbs / sft uniformly distributed load or 500 lbs concentrated load applied at midspan.

F. Stairway and ladder design shall conform to the latest federal and state 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 federal and state OSHA requirements for pull-out and shear.

1.06 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 the Contractor.

C. When requested by the 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 the 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 federal and state OSHA standard for Climber Protection shall be submitted.

1.07 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.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver miscellaneous metal items in an undamaged condition. Damaged items shall be repaired or replaced to the satisfaction of the Owner at the expense of the 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 the Owner at the expense of the Contractor.

1.09 PROTECTION

A. All 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 the 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. The 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/A123M
2. Hardware of Steel or Iron: ASTM A153/A153M
3. Assembled Steel Products: ASTM A123/A123M

2.02 PLATES, SHEETS, SHAPES AND BARS

A. Steel: ASTM A36/A36M

B. Aluminum:

1. Plate and Sheet: Alloy 6061, Temper T6, ASTM B209/B209M
2. Extruded Shapes and Bars: Alloy 6061-T6, ASTM B221

C. Stainless Steel

1. Shapes and Bars: ASTM A276/A276M
2. Sheets: ASTM A240/A240M

2.03 TUBING

A. Steel:

1. Hot-Formed Welded and Seamless – ASTM A501/A501M, Grade C

2. Cold Formed – ASTM A500/A500M, Grade C

B. Aluminum: Alloy 6061-T6, ASTM B221

2.04 PIPE

A. Black finish unless otherwise specified, Type E or S, Grade B, Schedule 40, ASTM A53/A53M

B. Aluminum: Alloy 6061-T6, ASTM B429/B429M

2.05 EXPANSION ANCHOR BOLTS

A. In accordance with Section 03 15 00 - Concrete Accessories.

2.06 GRATING AND STAIR TREADS

A. Steel:

1. Minimum 3/16 inch thick bearing bars manufactured from USS "Cor-Ten" Steel with Blaw-Knox Ponbake, Bordon Bo-Ly, or approved equal finish.

2. Stair treads shall have minimum 1 inch 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.

B. 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 inch diameter, Schedule 40. Fittings shall be extruded aluminum, machined to final shape. 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 inch 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 HATCHES

A. Frames shall be neatly mitered and shall have welded corners and anchors.

B. 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.

C. Provide each access hatch assembly manufactured as an integral unit, complete with all parts and ready for installation.

D. Aluminum access hatches and frames: Fabricate units of continuous welded aluminum construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces.

Furnish attachment devices and fasteners of type required to secure frames to types of floor or walkway shown on Drawings.

E. Covers: Covers shall be mill finish aluminum 1/4-inch diamond pattern, reinforced on the underside. Covers shall open to 90 degrees and lock automatically in that position.

F. Channel Frame: Channel frame shall be 1/4-inch extruded aluminum with bituminous coating applied to the exterior of the frame and with full anchor flange and welded anchors for concrete installation around the perimeter.

G. For watertightness, furnish frame with formed gutters a minimum of 3-inch wide by 3-inch deep, anchors, and a welded 1-1/2-inch drain coupling located on the right front corner of the channel frame or in another corner if shown on Drawings or specified otherwise. Fully weld gutter frame for absolute weathertightness.

H. Hinges, Pins, Bolts, and Nuts: Provide the covers with heavy 12 gauge, No. 316 stainless steel hinges and stainless steel pins. Hinges shall pivot so the cover does not protrude into channel frame. Hinges shall be through-bolted to the cover with stainless steel lock bolts and shall be through-bolted to the frame with stainless steel bolts and lock nuts.

I. Springs, Tubes, Shoes, Plates, Enclosures, and Operators: Provide the covers with manufacturer's standard springs, tubes and caps, tube or spring enclosures, operators, support plates, and shoes, which shall allow ease of operation through the entire 90-degree arc of opening, and act as a check in retarding downward motion when being closed. Tube and spring enclosures shall prevent accumulation of moisture, grit, and debris inside the tube and spring assembly.

J. Hold-Open Arms: Provide the covers with hold-open arms with guides which automatically lock the covers in the open position. Vinyl covered release handles shall be provided and conveniently located for closing.

K. Interior Snap Lock and Lock Strike: Provide a stainless steel snap lock and lock strike with a stainless steel fixed turn handle and appropriate stainless steel bolts mounted on the underside of the covers.

L. Exterior Lift Handle: Provide the covers with a stainless steel lift handle designed to be flush with walking surface when not in use.

M. Locking and Latching Devices: Provide the covers with the following locking or latching device and related hinged lid, flush gasketed removable screw plug, or threaded cover plug as noted:

1. Interior access hatches shall have removable exterior latch handle with plug: Provide removable exterior stainless steel latch handle and latch release protected by a flush gasketed removable screw plug.

2. Exterior access hatches shall have cylinder lock: Provide a brass cylinder lock with keyway protected by a threaded cover plug. Equip lock with cylinder and keys as specified.

N. Hardware Finish: Except where noted otherwise, all hardware shall be zinc plated and chromate sealed.

O. Accessories:

1. Provide ladder safety posts at fixed ladders and manhole rungs located below access hatches.

a. Safety posts shall be designed with telescoping section that locks automatically when fully extended. Up and down movement shall be controlled by a stainless steel spring balancing mechanism.

b. Unit shall be completely assembled with fasteners for securing to ladder rungs in accordance with manufacturer’s instructions. Finish to match ladder served.

c. Safety post shall be Bilco Ladder Up, or approved equal.

2. Provide fall prevention device below floor doors.

a. The fall prevention device shall be permanently installed fall-through prevention system that is easily retractable for full access and allows visibility for inspection.

b. The product must be FRP or stainless steel Type 316. Grating shall have a live load capacity of 100 pounds per square foot.

2.11 FABRICATION

A. General:

1. Miscellaneous steel fabrications shall conform to AISC 303. Welding where permitted and performed shall be in accordance with AWS D1.1/D1.1M.

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.

3. 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.

4. 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. All 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 or greater in length.

D. Lintels:

1. Steel lintels shall be provided for openings as shown and scheduled. Lintels shall have not less than four 4 inches of bearing on each end and shall have an additional 1 inch of bearing at each end for each 1 foot of clear span over four 4 feet, 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 deep measured from the interior and exterior faces of the masonry wall.

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

E. Guard Chains:

1. Where indicated on the Plans, chains shall be 3/16 inch 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.

F. Guard Posts:

1. Guard posts shall be 6 inch diameter, steel pipe conforming to ASTM A53/A53M, 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

    c. Total dry film thickness 4 - 6 mils

2.12 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 all dirt, rust, and all 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, 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 all 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 42 inch below finished grade in a concrete foundation as shown on the Plans. Guard posts shall extend 5 feetabove finished grade.

3.05 INSTALLATION OF RAILINGS

A. Provide pipe railing system with maximum 8 foot maximum post spacing and minimum 42 inch railing height to top rail. Top rail of handrailing system shall be 34 inches high as measured from the leading edge of any tread. Provide minimum 3 inch 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 less in length than thickness of concrete.

3.06 STEEL LINTEL SCHEDULE

Wall Thickness (inches)	Opening Length	Description	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"	
	3'-6" to 6'-6"	3 - 5"x5"x5/16"	LLH, 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.

3.07 INSTALLATION OF HATCHES AND FLOOR DOORS

A. Comply with manufacturer's instructions for installation of floor, pit, and sidewalk doors.

B. Coordinate installation with Work of other trades.

C. Preparatory Work: For normal flush installation, set frames accurately in position, recessed below the finished grade or floor level with cover face panels plumb or level in relationship to adjacent finish surfaces.

1. If unit is watertight type, unit should be set with slight pitch in direction of drain coupling.

D. All four corners of the frame shall be in the same plane; verify that leaves are seated properly on frame all around. Securely attach units to supports.

E. For flush installation, pour concrete to top of frame. Aluminum surfaces in contact with concrete shall be coated with a bituminous coating prior to installation.

F. Adjust hardware and covers after installation for proper operation.

G. Remove and replace covers or frames which are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 05 50 01
MISCELLANEOUS METAL WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 60 00 - Grouting

B. Section 05 55 13 - Wedgewire Screens

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications:

1. MIL-PRF-907F Anti-seize Thread Compound, High Temperature

B. Codes:

1. OSHA 1927.10 Fixed Ladders

C. Aluminum Association Designation System (AA):

1. AA-M32C22A41 Aluminum Assn.

D. American Association of State Highway and Transportation Officials:

1. AASHTO HL-93 Truck Loading

E. American Institute of Steel Construction (AISC):

1. AISC Manual of Steel Construction

F. American Society for Testing and Materials (ASTM):

1. ASTM A36 Carbon Structural Steel
2. ASTM A48 Gray Iron Castings
3. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A193 Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Application
7. ASTM A194 Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service
8. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
9. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes
10. ASTM A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
11. ASTM A325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
12. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
13. ASTM A992 Structural Steel Shapes

14. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
15. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength

G. American Nation Standards Institute (ANSI):

1. ANSI/AWS D1.1 Structural Welding Code - Steel
2. ANSI/AWS D1.2 Structural Welding Code - Aluminum
3. ANSI/AWS D1.6 Structural Welding Code - Stainless Steel
4. ANSI/AWS QC1 Standard for AWS Certification of Welding Inspectors

1.04 SUBMITTALS

A. Shop Drawings:

1. Shop Drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the WORK.
2. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

B. Anchors:

1. Submit an ICC-ES or IAPMO-UES report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor.
2. Submit manufacturer's recommended installation instructions and procedures for anchors.
3. Upon review by the Owner, these instructions shall be followed specifically.
4. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.
5. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be signed and stamped by a Professional Engineer registered in the state of Ohio.

C. Grating:

1. Submit layout drawings for grating, showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners.
2. Submit load and deflection tables for each style and depth of grating used.

D. Wedgewire Screens:

1. Submittal for Wedgewire screen support frames and anchorages shall be coordinated with the requirements of Section 05 55 13.

1.05 QUALITY ASSURANCE

A. Weld procedures and welder qualifications shall be available in the Contractor's field office for review.

B. Welding Special Inspection will be performed by the Owner in accordance with the enforceable Building Code.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Carbon Steel:

Wide Flange Shapes	ASTM A992
Shapes, Plates, Bars	ASTM A36
Pipe, Pipe Columns, Bollards	ASTM A53, Type E or S, Grade B standard weight unless indicated otherwise
HSS	ASTM A500 Grade B

B. Corrosion Protection:

1. Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water or wastewater shall be coated in accordance with the requirements of Section 09 96 00 - Painting and shall not be galvanized prior to coating.
2. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. Stainless Steel:

1. Unless otherwise indicated, stainless steel metalwork and bolts shall be fabricated from Type 316 stainless steel.

D. Aluminum:

1. Unless otherwise indicated, aluminum metalwork shall be fabricated from Alloy 6061-T6.
2. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with the requirements of Section 09 90 00.

E. Cast Iron:

1. Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B, or better.

2.02 LADDERS

A. Materials:

1. Ladders shall be fabricated entirely of Type 316 stainless steel unless specified otherwise on the Drawings.

B. Pop-Up Extension:

1. Every ladder that does not have an exterior handhold shall be equipped with a pop-up extension.
2. The pop-up extension device shall be manufactured of the same material and finish as the ladder, and shall be provided with a telescoping tubular section that locks automatically when fully extended.
3. Upward and downward movement shall be controlled by stainless steel spring balancing mechanisms.
4. The units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer’s instructions.
5. Pop-up extension shall be the LadderUP Safety Post as manufactured by Bilco or approved equal.

2.03 METAL GRATING

A. General:

1. Metal grating shall be of the indicated design, size, and type.
2. Grating shall be supported around an opening by support members.

3. Where grating is supported on concrete, unless otherwise indicated provide embedded support angles that match the grating material and are mitered and welded at their corners.
4. Banding:
    a. The grating shall be completely banded at edges and cutouts.
    b. The banding material and cross-section shall be equivalent to the bearing bars.
    c. The banding shall be welded to each cut bearing bar.
5. The grating pieces shall be fastened to each support in 2 locations.
6. Where the grating depth is not indicated, provide grating within allowable stress levels and which shall not exceed a deflection of 1/4 inch or the span divided by 180, whichever is less.
7. Design Loading:
    a. For standard duty grating, the loading to be used for determining stresses and deflections shall be the uniform live load of 100 psf, or a concentrated load of 1000 pounds.
    b. For heavy duty grating, the loading used for determining stresses and deflections shall be in accordance with AASHTO HL-93.
8. All grating shall be provided with The Intimidator ManLock by McGard or approved equal locking mechanism.
    a. ManLock shall use ½" – 13- 2.75" bolt

B. Material:
1. Except where indicated otherwise, bar grating shall be fabricated entirely of:
    a. Heavy duty welded steel, hot-dipped galvanized after fabrication
        1) Bearing Bars: shall be spaced at 15/16 inch center-to-center. Depth of bar shall be as indicated on drawings.
        2) Cross Bars: shall be spaced at 4 inches center-to-center
        3) Surface: plain
        4) Loading: HL-93
        5) Finish: hot-dipped galvanized
        6) Fabrication and Tolerances: in accordance with the NAAMM Heavy Duty metal bar Grating Manual
2. Grating that may be partially or wholly submerged shall be fabricated of A316L stainless steel.

2.04 CHECKERED PLATE

A. Checkered plate shall be provided with a pattern of raised lugs on one face, and shall be smooth on the opposite face.

B. Lugs:
1. Lugs shall be a minimum of one inch in length and raised a minimum of 1/2 inch above the surface.

C. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in 2 orthogonal directions.
1. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.

D. Where no material is indicated, the plates shall be fabricated from aluminum.

E. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4 inch, or the span divided by 240, whichever is less.

2.05 IRON CASTINGS

A. General:

1. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects.

2. The castings shall be smooth and well cleaned by shotblasting.

3. Covers and grates shall fit together evenly, such that the cover fits flush with the surrounding finished surface and such that the cover does not rock or rattle when a loading is applied.

4. Round covers and frames shall be provided with machined bearing surfaces

B. Covers with matching frames shall be designed for AASHTO HL-93 loading, heavy traffic type and conform to the requirements of ASTM A 48 Class 30 unless indicated otherwise.

2.06 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application):

1. Bolts, anchor rods, anchor bolts, washers, and nuts shall be fabricated from steel as indicated.

2. Threads on galvanized bolts, rods and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

3. Except as otherwise indicated, steel for bolt material, anchor rods, anchor bolts, and cap screws shall be in accordance with the following requirements:

a. Structural Connections: ASTM 307, Grade A or B, hot-dip galvanized

b. Headed Anchor Rods and Anchor Bolts: ASTM F1554, Grade 36, hot-dip or mechanically galvanized with Grade A matching nuts

c. High-Strength Bolts, where indicated: ASTM A325

d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7

B. Corrosive Service:

1. Bolts, anchor rods, anchor bolts, nuts, and washers in the locations listed below shall be fabricated from stainless steel as indicated.

a. Buried locations

b. Submerged locations

c. Locations subject to seasonal or occasional flooding

d. Inside hydraulic structures below the top of the structure

e. Inside buried vaults, manholes, and structures

f. Locations indicated or designated by the Owner to be provided with stainless steel bolts

2. Unless otherwise indicated, stainless steel bolts, anchor rods, anchor bolts, nuts, and washers shall be fabricated from Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

C. Coating:

1. Threads on stainless steel bolts and rods shall be protected with an anti-seize lubricant suitable for submerged stainless steel bolts, meeting government specification MIL-A-907E.
2. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.
3. Anti-seize lubricant shall be classified as acceptable for potable water use by the NSF.
4. Anti-seize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL, 60131, AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or approved equal.

D. Bolt Requirements:

1. The bolt and nut material shall be free-cutting steel.

E. The nuts shall be capable of developing the full strength of the bolts.

1. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.
2. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
3. Bolts and nuts shall be installed with washers fabricated from material matching the base material of bolts, except that hardened washers for high-strength bolts shall conform to the requirements of the AISC Specification.
4. Lock washers fabricated from material matching the bolts shall be installed where indicated.
5. The length of each bolt shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

F. Adhesive Anchors:

1. General:
    a. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors.
    b. No substitutions will be considered unless accompanied with a current ICC- ES or IAPMO-UES report verifying strength and material equivalency.
2. Epoxy Anchors:
    a. Epoxy adhesive anchors are required for drilled anchors for outdoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars.
    b. Epoxy shall be in accordance with the requirements of Section 03 60 00 - Grouting.
    c. Threaded rod shall be galvanized for general purpose applications and fabricated from Type 316 stainless steel for use in corrosive applications.
    d. Epoxy anchors shall not be permitted in areas where the concrete temperature is in excess of 100 degrees F or higher than the limiting temperature recommended by the manufacturer, whichever is lower.
    e. Epoxy anchors shall not be used where anchors are subject to vibration or fire.
    f. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.
3. Unless otherwise noted, threaded rod shall be galvanized steel.

G. Expanding-Type Anchors:

1. Expanding-type anchors, if indicated or permitted, shall be galvanized steel unless otherwise noted, shall be of the expansion type, and shall be Simpson Strong-Tie Strong-Bolt 2 anchors, Hilti Kwik-Bolt TZ anchors, Powers Power- Stud+ SD1 or SD2 anchors, or equal.

2. Lead caulking anchors will not be permitted.

3. Minimum size shall be as indicated on the Contract Documents.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

H. Non-Shrink Grouted Anchors:

1. Grouted anchors, if indicated or permitted, shall be grouted with a non-shrink cementitious grout in accordance with the manufacturer's recommendations.

2. Non-shrink grout material shall be Class B or C in accordance with Section 03 60 00 - Grouting.

2.07 IMPACT ANCHOR

A. Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force.

B. The pin shall be provided with a zinc sleeve with a mushroom-style head and stainless steel nail pin.

C. Anchors shall be Zinc Nailon Anchors, manufactured by Simpson Strong- Tie, Inc., Metal Hit Anchors, manufactured by Hilti, Inc., Rawl Zamac Nailin, manufactured by the Rawlplug Company, or approved equal.

PART 3 EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

3.02 WELDING

A. Method:

1. Welding shall be performed by the metal-arc method or gas-shielded arc method as described in the American Welding Society "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. The qualification of the welders shall be in accordance with the AWS Standards.

B. Quality:

1. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained in order to minimize distortion and for control of dimensions.

2. Weld reinforcement shall be as indicated by the AWS Code.

3. Upon completion of welding, remove weld splatter, flux, slag, and burrs left by attachments.

4. Welds shall be repaired in order to produce a workmanlike appearance, with uniform weld contours and dimensions.

5. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

3.03 GALVANIZING

A. Structural steel plate's shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123.

B. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.

C. Bolts, anchor rods, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A153.

D. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.

2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.

3. The coating shall be applied to at least 3 mils dry film thickness, and shall be Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide, or equal.

3.04 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions.

B. Holes shall be roughened with a brush on a power drill, and then cleaned and dried.

C. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength.

D. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

E. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars.

F. All abandoned drilled holes shall be filled with Epoxy Anchor Grout.

END OF SECTION

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Aluminum bar stock railings.

1.02 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.03 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional Engineer responsible for their preparation.

D. Qualification Data: For qualified professional Engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive Engineering analysis by a qualified professional Engineer, using performance requirements and design criteria indicated.

B. General: In Engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.
2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
    a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.

b. Infill load and other loads need not be assumed to act concurrently.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.06 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.02 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Alloys and tempers in first six paragraphs below are typical for products listed when used in railings; revise to suit structural performance requirements.

C. Yield strength for Alloy 6063-T5/T52 is 15 to 16 ksi (105 to 110 MPa).

D. Extruded Bars and Tubing: ASTM B 221, Alloy 6063-T5/T52.

E. Yield strength for Alloy 6063-T6 is 25 ksi (172 MPa).

F. Yield strength for Alloy 6061-T6 is 32 to 35 ksi (220 to 240 MPa). Plate and Sheet: ASTM B 209, Alloy 6061-T6.

G. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

H. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.03 FASTENERS

A. General:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.

2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

3. Aluminum Railings: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

3. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

2.04 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.05 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or non-welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:

1. By flush bends.

L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.06 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.07 ALUMINUM FINISHES

A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

A. Non-welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.04 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.

2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.05 ADJUSTING AND CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.06 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 55 13
WEDGEWIRE SCREENS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide wedge wire screen(s) as specified herein and as shown on the Drawings.

1.02 REFERENCES

A. Section 05 50 01 - Miscellaneous Metal Work

1.03 QUALITY ASSURANCE AND QUALITY CONTROL

A. Wedgewire Screen: Screens shall be manufactured by an ISO 9000 Certified company, fabricated by ASME Section IX Certified welders and the manufacturer shall provide evidence of experience in having supplied at least five assemblies of similar designs which have been in successful service for at least three years.

B. Design wedgewire screens and associated support frames and anchorages to support the loads shown on the Drawings. Support frames and anchorages shall be designed in accordance with Section 05 50 00 – Miscellaneous Metal Work05 50 00 - Metal Fabrications.

1.04 SUBMITTALS

A. Submit shop drawings, manufacturer's data and literature in accordance with these specifications prior to manufacturing screens. Attach a copy of the American Iron and Steel Certification for Project.

B. Wedge wire Screens: Submit drawings showing screen length, width, depth, slot opening, materials of construction and assembly weight.

C. Submit a Certificate of Design along with calculations prepared by a Registered Professional Engineer in the State of Ohio.

D. Do not fabricate wedgewire screens before shop drawings are approved by the Owner.

1.05 WARRANTY

A. Manufacturing Warranty Period: One year from acceptance. Replace items found to be defective within the one year period.

PART 2 PRODUCTS

2.01 SCREEN

A. Manufacturer: Hendrick Screen Company, Owensboro, Kentucky, Industrial Screen Products, Placerville, California; Amistco Separation Products, Inc., Alvin, Texas or approved equal.

B. Construction of screen shall be of resistance welded V-wire screen construction. The V-wires shall be spaced 1-inch apart during manufacture via resistance welding each wire at every intersection to the support members which run perpendicular to the wires. Support members shall be spaced 1-inch apart. The inlet slots shall widen inwardly from the screen surface to minimize the chance of debris entrapment in the screen openings. The screens shall be welded into a stainless steel angle frame as shown on the Drawings. Angle frames shall be connected to the supporting steel columns as shown on the drawings.

C. Strength: Design stress when determining strength shall be two thirds of material yield strength. Strength calculations verifying compliance with these criteria shall be provided upon request.

D. Wire and slot: the surface wire shall be v-wire. The v-wire shall have a relief angle of no less than 5°. Minimum individual v-wire size and geometry shall be tapered from a triangular tip to a width of 0.090-inches and a depth of 0.150-inches. V-wire size shall be increased if required by calculation. Slot size shall be controlled and continuously monitored during manufacture. The slot openings shall have a standard deviation of no greater than 0.005-inch throughout the assembly.

E. Material: Material for V-wire, support members and angle frames shall be type 316L stainless steel.

PART 3 EXECUTION

3.01 GENERAL

A. Fabricate, deliver and install complete wedgewire screen units in accordance with the requirements for miscellaneous metal work, established elsewhere in the Contract Documents.

END OF SECTION

SECTION 06 11 40
WOOD BLOCKING AND CURBING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Wood blocking for miscellaneous supports.

B. Preservative treatment of wood. Wood used in conjunction with re-roofing activities shall have preservative treatment approved for use by the Approved Roofing System Manufacturer, for use with their single-ply membrane system.

1.02 REF

A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

B. AWPA (American Wood Preservers Association) U1 – User Category System.

C. AWPA (American Wood Preservers Association) C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.

D. NFPA: National Forest Products Association.

E. SPIB: Southern Pine Inspection Bureau.

F. WCLIB: West Coast Lumber Inspection Bureau.

G. WWPA: Western Wood Products Association.

1.03 SUBMITTAL

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.04 QUALITY ASSURANCE

A. Lumber Grading Agency: Certified by ALSC.

PART 2 PRODUCTS

2.01 MATERIALS

A. Lumber Grading Rules: NFPA.

B. Miscellaneous Framing: Stress Group D, No. 2 Southern Pine or No. 2 Douglas Fir, 19 percent maximum moisture content, pressure preservative treat.

2.02 ACCESSORIES

A. Fasteners and Anchors:

1. Fasteners: Hot-dipped galvanized steel for wood locations, unless noted otherwise.

a. Anchors: Hot-dipped Galvanized; Toggle bolt type for anchorage to hollow masonry; Expansion shield and lag bolt type for anchorage to solid masonry or concrete; Bolt or ballistic fastener for anchorages to steel. Note – anchors shall be suitable for use with ACQ treated lumber.

2.03 FACTORY WOOD TREATMENT

A. Wood preservative:

1. All materials shall be pressure treated to meet AWPA UC3B with .25 pounds per cubic foot, minimum retention, of Alkaline Copper Quat (ACQ).

PART 3 EXECUTION

3.01 FRAMING

A. Set members level and plumb, in correct position.

B. Place horizontal members flat, crown side up.

3.02 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply two coats of preservative treatment on wood where ends have been field cut for erection.

C. Allow preservative to dry prior to erecting members.

END OF SECTION

SECTION 07 10 00
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 the Engineer in accordance with Section 01 33 00 - Submittal Procedures.

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 foam with a minimum thickness of 2-inches, unless otherwise shown on the Plans, conforming to ASTM C578, Type IV:

1. Minimum compressive strength: 18 psi
2. Maximum water vapor transmission: 1.1 U.S. perm per inch
3. Thermal resistance: 5.0 F-sft-hr/Bt

2.02 VAPOR BARRIER

A. Use a 6 mil, 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 or 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

1. Dow "Styrofoam"
2. United States Gypsum Company "Formula R
3. Engineer approved equal.

B. Vapor Barrier

1. Polyamerica "Visqueen"
2. ADPI Enterprises, Inc. "Durethene"

3. Engineer approved equal.

C. Crystalline Waterproofing:

1. Xypex Concentrate

2. 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

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 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 gal per 100 square feet 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 gal per 200 square feet 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 per square yard per coat.

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 14 16
COLD FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Polyurethane waterproofing.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.03 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.

2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Show locations and extent of waterproofing.

2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Qualification Data: For Installer.

D. Sample Warranties: For special warranties.

1.04 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

1.05 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation specified in other Sections.

b. Minimum curing period.

c. Forecasted weather conditions.

d. Special details and sheet flashings.

e. Repairs.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.02 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Construction Systems.

b. Carlisle Coatings & Waterproofing Inc.

c. CETCO.

d. Tremco Incorporated.

B. Single-Component, Reinforced, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Construction Systems.

b. Carlisle Coatings & Waterproofing Inc.

2.03 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

C. Sheet Flashing: 50-mil-(1.3-mm-) minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric, manufacturer's standard weight.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.04 PROTECTION COURSE

A. Protection Course: ASTM D 6506, semi rigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as fol-lows:

1. Thickness: 1/4 inch (6 mm), nominal.

2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer.

2.05 MOLDED-SHEET DRAINAGE PANELS

A. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panels consisting of a studded, non-biodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate of not less than 2.8 gpm per ft. (35 L/min. per m).

2.06 INSULATION

A. Board Insulation: Extruded-polystyrene board insulation according to ASTM C 578, square or shiplap edged.

1. Type VI, 40-psi (276-kPa) minimum compressive strength.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements and other conditions affecting performance of the work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.

2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.03 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471.

B. Apply waterproofing in two (2) separate applications and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.04 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

1. Comply with ASTM C1193 for joint-sealant installation.

2. Apply bond breaker on sealant surface, beneath preparation strip.

3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two (2) separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.05 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C898/C898M and ASTM C1471.

B. Apply primer over prepared substrate unless otherwise instructed in writing by water-proofing manufacturer.

C. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one (1) or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm).

2. Apply waterproofing to prepared wall terminations and vertical surfaces.

3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

D. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 70 mils (1.8 mm).

2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.

3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

F. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For horizontal applications, install protection course loose laid over fully cured membrane.

2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3. Molded-sheet drainage panels or Board insulation may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.06 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation and protection course before installing drainage panels.

3.07 INSULATION INSTALLATION

A. Install one (1) or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.08 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 19 00
WATER REPELLENT COATING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Water repellent coating applied to exposed, exterior concrete surfaces.

1.02 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 04 20 00 - Unit Masonry

C. Section 07 92 00 - Joint Sealants

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.

B. Product Data: Provide details of product description, tests performed, limitations to coating, cautionary procedures required during application, and chemical properties including percentage of solids.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.04 QUALIFICATIONS

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

B. Applicator: Company specializing in performing the work of this section with minimum three years' experience.

1.05 MOCKUP

A. Provide mockup of surface to be coated under provisions of Section 01 45 00 - Quality Control.

B. Prepare coated surface 36 x 36 inch (1 x 1 m) in size.

C. Apply material to test area using the same equipment as intended for the job. Sample area will be allowed to cure for a minimum of 48 hours.

D. Mockup may, at the discretion of the Engineer, remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 - Product Requirements.

B. Protect coating liquid from freezing.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not apply coating when ambient or surface temperature is lower than 50 degrees F (10 degrees C) or higher than 100 degrees F (38 degrees C).

1.08 EXTRA MATERIALS

A. Furnish under provisions of Section 01 77 00 - Closeout Procedures.

B. Provide two gallons of coating, in manufacturer's labeled, unopened, containers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ProSoCo Inc.:

1. Concrete Block, Concrete Brick, Cast Stone and Unpolished Limestone – Weather Seal Blok-Guard & Graffiti Control

B. BASF:

1. Concrete Block, Concrete Brick, Cast Stone and Unpolished Limestone – MasterProtet H-440VT

C. Substitutions: Under provisions of Section 00 63 25 - Substitution Request Form.

2.02 MATERIAL

A. A water repellent sealer for exterior, vertical, above-grade applications on concrete and masonry. A clear, water-repellent, film-free formula protects buildings from moisture damage and reduces efflorescence, atmospheric staining, and scaling associated with freeze/thaw cycles.

B. Water repellent material shall have the following minimum performance.

C. Reduction in water absorption: 98.9 percent per ASTM C67.

D. Reduction in water absorption: 94.8 percent per ASTM C642.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify joint sealants are installed and cured.

B. Verify compatibility of material with joint sealants used.

C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of coating.

3.02 PREPARATION

A. Delay work until masonry mortar or concrete substrate is cured a minimum of 30 days or as recommended by the manufacturer of the water repellent coating.

B. Remove loose particles and foreign matter.

C. Remove oil or foreign substance with a chemical solvent which will not affect coating.

D. Scrub and rinse surfaces with water and let dry.

3.03 APPLICATION

A. Apply coating in accordance with manufacturer's instructions.

B. Apply each coat of material in one continuous, uniform coat; actual number of coats applied shall be as recommended by material manufacturer to meet manufacturer's standard warranty requirements.

3.04 PROTECTION TO FINISHED AND ADJACENT WORK

A. Protect adjacent surfaces not scheduled to receive coating.

B. Protect landscaping, property, and vehicles.

C. If applied to unscheduled surfaces, remove immediately by a method instructed by coating manufacturer.

END OF SECTION

SECTION 07 53 23
SINGLE PLY ROOFING FULLY ADHERED CONVENTIONAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Membrane roofing, base flashings roofing membrane and counter flashings.

B. Pre-fabricated pipe supports for placement on roofing membrane, to support utilities serving roof-top equipment.

C. Rigid insulation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06 11 40 - Wood Blocking and Curbing

B. Section 07 62 00 - Sheet Metal Flashing and Trim

1.03 REFERENCE STANDARDS

A. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

B. ASTM D412 - Rubber Properties in Tension.

C. ASTM D471 - Standard Test Method for Rubber Property - Effect of Liquids.

D. ASTM D624 - Rubber Property - Tear Resistance.

E. ASTM E96 - Water Vapor Transmission of Materials.

F. FM 4470 (Factory Mutual Engineering Corporation) - Roof Assembly Classifications.

G. NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.

H. UL 790 - Fire Hazard Classifications.

1.04 SYSTEM DESCRIPTION

A. Elastomeric Sheet Membrane Conventional Roofing System: One ply membrane system with insulation.

B. Provide tapered insulation for saddles/crickets as necessary to direct flow for positive drainage around roof penetrations.

1.05 SUBMITTALS FOR REVIEW

A. Product Data: Provide characteristics on membrane materials, flashing materials, insulation, and adhesive.

B. Shop Drawings: Indicate setting plan for insulation, joint and termination detail conditions and conditions of interface with other materials; termination condition at existing sidewalls.

C. Samples: Submit two 6 x 6 inch in size illustrating insulation.

1.06 SUBMITTALS FOR INFORMATION

A. Section 01 33 00 - Submittal Procedures: Procedures for submittals.

B. Manufacturer's Installation Instructions: Indicate special precautions required for seaming the membrane.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer's Field Reports: Submit under provisions of Section 01 45 00 - Quality Control.

E. Reports: Indicate procedures followed; ambient temperatures, humidity, wind velocity during application.

1.07 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with ten (10) years' experience.

B. Installer:

1. Company specializing in performing the work of this section with ten (10) years' experience and approved by system manufacturer.

2. Installer must be certified in the last 3 years by the system manufacturer to install their provided system per these specifications in accordance with the following:

a. Holcim Elevate (Firestone): Master Contractor

b. Carlisle: Perfection Council or Award or ESP Award

c. Johns Manville: Summit Club Member (or higher)

3. **Provide documentation regarding certification as part of bid submittal.**

C. Perform Work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable Michigan Building Code for roof assembly fire hazard requirements.

B. UL 790: Class A Fire Hazard Classification.

C. FM 4470: Roof Assembly Classification, of Class 1 Construction, wind uplift requirement of 1-90, in accordance with FM Construction Bulletin 1-28.

1.09 PRE-INSTALLATION MEETING

A. Section 01 31 19 - Project Meetings: Pre-installation meeting.

B. Convene one week before starting work of this section.

1.10 DELIVERY, STORAGE, AND PROTECTION

A. Store products in weather protected environment, clear of ground and moisture.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply roofing membrane during inclement weather and ambient temperatures below 32 degrees F or above 95 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.12 COORDINATION

A. Coordinate work under provisions of Section 01 31 19 - Project Meetings.

B. Coordinate the work with the installation of associated metal flashings, as the work of this section proceeds.

1.13 WARRANTY

A. Manufacturer: Provide 20-Year, Non-Prorated – Total System Roofing Warranty covering roof membrane, flashings and insulation/cover board for all new installations. Roofing Manufacturer representative shall sign off and approve the roofing installation prior to warranty period commencing.

B. Contractor: Upon completion, Contractor shall also provide a 2-Year Workmanship Warranty to cover all leaks due to defective workmanship or materials. Warranty shall include metal flashing installation; warranty shall list location of flashings and total lengths of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS - MEMBRANE MATERIAL

A. Holcim Elevate (Formerly Firestone) – RubberGard EPDM Membrane (60 mil)

B. Johns Manville – 60NR

C. Carlisle - SureSeal (60 mil)

D. Substitutions –None permitted.

2.02 MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: EPDM non-reinforced, 0.060 inch thick, utilizing maximum roll width to reduce number of seams; color - black.

B. Seaming Materials: As recommended by membrane manufacturer.

2.03 ATTACHMENT MATERIALS

A. Surface Conditioner: As recommended by membrane manufacturer, compatible with membrane.

B. Membrane Adhesives: As recommended by membrane manufacturer.

C. Insulation Adhesive for Concrete Deck: As recommended by membrane manufacturer.

D. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

E. See “Accessories” for fasteners, termination bars and reglets.

2.04 INSULATION MATERIALS

A. Manufacturers – roofing membrane manufacturer shall approve all insulation and fastening components used with their roofing system.

B. Thermal resistance ratings specified are based on ASTM C1289 (2011) and are presented as a Long Term Thermal Resistance (LTTR) value, reflecting a product’s 15 year weighted average of the foam’s thermal resistance. Submittals shall indicate R-Value in LTTR format.

C. All insulation shall be approved by the roofing manufacturer for use with their roofing system, to obtain and maintain the warranty specified. Insulation shall be applied in minimum two layers (including the cover board), unless approved otherwise by roofing manufacturer:

1. Type 1 (High Density Cover Board): High Density rigid cover board shall be used over rigid insulation. Material to be approved for warranty requirements specified.

2. Type 2 (Thermal Insulation): Polyisocyanurate foam core bonded to universal fiber glass reinforced facer sheets.

3. Type 3 (Tapered Thermal Insulation): Similar to Type 2, polyisocyanurate foam core bonded to universal fiber glass reinforced facer sheets, tapered board.

D. Type 1: ASTM C1289, Type II, Class IV, Grade 2, high density polyisocyanurate rigid cover board; with the following characteristics:

1. Board Density: Minimum 100 PSI.

2. Board Size: 48 x 48 inch or 48 x 96 inch.

3. Board Thickness: 1/4 inch to 1/2 inch (as required for roofing system to be provided.)

4. Board Edges: Square.

E. Type 2: ASTM C1289, Type II, Class I, Grade 2 polyisocyanurate board insulation with the following characteristics:

1. Board Density: Minimum 20 PSI.
2. Board Size: 48 x 48 or 48 x 96 inch
3. Board Thickness per Layer: 1 inch minimum.
4. Thermal Value LTTR: Minimum R-Value of 5.7 for 1 inch board.
5. Board Edges: Square.

F. Type 3: ASTM C1289, Type II, Class I, Grade 2 tapered, polyisocyanurate board insulation with the following characteristics:

1. Board Density: Minimum 20 PSI.
2. Board Size: 48 x 48 inch
3. Slope – 1/8 to ¼ inch per foot as shown on the Drawings.
4. Board Thickness: ½ inch to 4 inch in a single layer.
5. Thermal Value LTTR: Minimum R-Value of 5.7 based on a typical tapered board thickness of 1 inch or greater.
6. Board Edges: Square.

2.05 FLASHINGS

A. Flexible Flashings: Same material as membrane EPDM; black color, as recommended by the manufacturer.

2.06 ACCESSORIES

A. Sealants: As recommended by membrane manufacturer to maintain warranty specified.

B. Stack Boots: Flexible boot and collar for pipe stacks through membrane.

C. Termination Bars: Stainless steel or aluminum with beveled edges to receive sealant cap after installation. Fasteners shall be non-corrosive, fastened at 12 inches O.C. max. Cut termination bars at inside and outside corners, do not bend around corners.

D. Reglet Terminations - Metal counter flashings shall be as specified in Section 07 62 00 - Sheet Metal Flashing and Trim.

E. Vapor Barrier – Provide Mfr. recommended vapor barrier over deck.

1. Prepare surfaces and prime per Mfr. recommendations.
2. At metal deck surfaces, install 5/8” DensDeck prior to installation of vapor barrier. Use stainless steel fasteners at all locations receiving DensDeck.
3. All penetrations through vapor barrier are to be sealed.

F. Roof Walk Pads: Minimum 30 inch x 30 inch, black cured polymer walkway pad with raised, non-slip profile, compatible with approved EPDM roofing membrane. Space pads with maximum 3 inch gap between pad edges to promote drainage.

PART 3 EXECUTION

2.07 EXAMINATION

A. Cover all equipment, tanks, vehicles, etc. at the interior of the building to protect from damage or falling debris during installation. Determine any conflicts with conduit, piping, lights, etc. mounted to the underside of the deck to ensure that these components are not damaged during installation.

B. Verify that surfaces and site conditions are ready to receive work.

C. Verify deck is supported and secure.

D. Verify deck is clean and smooth, free of depressions, waves, or projections.

E. Verify deck surfaces are dry and free of snow or ice.

F. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set.

2.08 PREPARATION

A. Concrete Deck - Fill surface honeycomb and variations with latex filler in concrete deck, as required by roofing manufacturer to establish suitable, acceptable insulation base surface. Infill roof openings were equipment is to be removed, as may be called for on the Drawings.

2.09 VAPOR RETARDER APPLICATION

A. Apply vapor retarder to precast concrete deck surface with adhesive in accordance with manufacturer's instructions.

B. Extend vapor retarder up and over parapet walls and curbing.

C. Lap flexible flashing over vapor barrier of wall construction to provide continuity of vapor barrier seal.

2.10 INSULATION APPLICATION

A. Concrete Roof Deck

1. Apply adhesive to concrete deck in accordance with adhesive and insulation manufacturer's instructions. Embed insulation into adhesive with full contact.

2. If multiple layers of insulation are used over the concrete deck, apply adhesive to the top surface of insulation. Embed the second layer of insulation into adhesive, with joints staggered minimum 6 inch from joints of first layer.

3. Adhesive used shall be selected and installed in accordance with the manufacturer’s requirements based on the insulation used and an FM I-90 uplift requirement.

4. Insulation glued to the concrete deck.

a. Outdoor temperatures must be 35 degrees and rising for adhesive installation.

b. Store adhesive in 60 degree to 80 degree temperature until ready to use.

c. Adhesive shall be 60 degrees to 80 degrees when installed.

d. Adhesive shall be installed in accordance with the manufacturer’s requirements based on the insulation used and an I-90 uplift requirement.

e. Verify proper mixing prior to applying adhesive to deck, no marbling in the adhesive is allowed.

f. Do not allow bead of adhesive to “skin over” before installing insulation board.

B. All Insulation Installation:

1. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

2. Where tapered boards are provided for general roof surface slope, utilize a minimum slope of 1/8 inch per foot from the high side to the low side for positive drainage. Use ½ inch per foot on all cants, saddles, crickets.

3. Apply no more insulation than can be covered with membrane in same day.

2.11 MEMBRANE INSTALLATION

A. Apply membrane in accordance with manufacturer's instructions.

B. Place membrane in final position and fold back per manufacturer’s instructions. Place membrane so that the seams shed water. Remove dusting agent and dirt from backside of membrane.

C. Apply adhesive at a rate as recommended by the Manufacturer.

D. Test adhesive for Readiness (Touch-Push Test).

E. Roll out membrane, free from air pockets, wrinkles, or tears. Firmly press sheet into place without stretching.

F. Overlap edges and ends and seal in accordance with the manufacturer’s requirements.

G. Shingle joints on sloped substrate in direction of drainage.

H. Extend membrane up a minimum of 8 inches onto vertical surfaces.

I. Seal membrane around roof penetrations.

2.12 FLASHINGS AND ACCESSORIES

A. Fabricate custom roofing expansion joints to replace existing joints as specified and shown on the Drawings.

B. Seal flashings and flanges of items penetrating membrane.

C. Equipment drains, gas lines and pipe penetrations; conduits, vents etc. shall be supported and flashed per the roofing manufacturer’s warranty requirements, as a part of this Work.

D. Pipe Supports: On roof pipe supports shall be DuraBlok or equal, non-penetrating base supports.

E. Include extra thickness of roofing material under pipe supports. Pieces shall be fully adhered to membrane underneath.

2.13 FIELD QUALITY CONTROL

A. Section 01 45 00 - Quality Control: Field inspection and testing.

B. Manufacturer shall inspect the completed roof for proper installation and the Engineer shall be notified a minimum of 48 hours in advance of the date of the inspection.

C. Correct identified defects or irregularities.

2.14 CLEANING

A. In areas where finished surfaces are soiled by Work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

B. Repair or replace defaced or disfigured finishes caused by work of this section.

2.15 PROTECTION OF FINISHED WORK

A. Protect building surfaces against damage from roofing work.

B. Where traffic must continue over finished roof membrane, protect surfaces.

C. Protect installation from damage until acceptance by Owner.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Sill flashings, drip edges and formed metal trim pieces not specified elsewhere.

B. Metal edge and preformed roof flashings.

C. Counterflashings over base flashings.

D. Metal Parapet Caps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 07 92 00 - Joint Sealants

B. Section 09 96 00 - Painting

1.03 REFERENCE STANDARDS

A. AISI (American Iron and Steel Institute) - Stainless Steel -Uses in Architecture.

B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.

C. ASTM B32 - Solder Metal.

D. ASTM B209 - Aluminum and Alloy Sheet and Plate.

E. ASTM D4586 - Asphalt Roof Cement, Asbestos-Free.

F. FS O-F-506 - Flux, Soldering, Paste and Liquid.

G. NRCA (National Roofing Contractors Association) - Roofing Manual.

H. SMACNA - Architectural Sheet Metal Manual.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Submit two samples 6 x 6 inch in size illustrating metal finish color for each type for flashing to be provided.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with AISI, CDA, NRCA and SMACNA standard details and requirements. Several SMACNA standard documents and fabrications are referred to, in this Work. Maintain one copy of each document/ cut sheet on site. Where not specifically detailed or specified, comply with SMACNA's "Architectural Sheet Metal Manual". Conform to dimensions and profiles recommended unless more stringent requirements are indicated.

B. Maintain one copy of each document on site.

1.06 QUALIFICATIONS

A. Fabricator and Installer: Company specializing in sheet metal flashing work with 3 years documented experience.

1.07 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section, under provisions of Section 01 31 19 - Project Meetings.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

1.09 COORDINATION

A. Coordinate work under provisions of Section 01 31 19 - Project Meetings.

B. Coordinate with the work of Section 07 62 00 - Sheet Metal Flashing and Trim for installing flashing in conjunction with roofing materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fabrications shall be factory fabricated to the extent possible. Contractor may elect to provide field fabricated copings and flashings as long as the metals are as specified and fabricated as called for in this section. Manufacturer shall note flashing configurations as required on the drawings and Contractor shall provide existing field dimensions for fabrications as required for the work. Provide product configurations by one of the following:

1. IMETCO, Inc.
2. PAC-CLAD Peterson
3. W.P. Hickman

2.02 SHEET MATERIALS

A. Galvanized Steel Sheet: Mill phosphatized, minimized spangle, zinc coating designation G90 per ASTM A 653.

B. Galvanized Steel Gages: Metal gages shall be as specified below. If a fabrication is required that is not listed below, Contractor shall follow minimum SMACNA galvanized steel gage recommendations for that item. Unless noted otherwise on the Drawings, use minimum 22 gage for all items except:

1. Use 24 gage for continuous cleats, reglets and counter flashings.
2. Use 24 gage for gravel stop/fascias up to 5 inches high (over 5 inches use 22 gage.)
3. Use 24 gage for downspouts; hanger fabrications shall be minimum 1/16” x 1” flat stock, color to match downspouts.

2.03 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal (unless noted otherwise on the Drawings), with soft neoprene washers.

B. Protective Backing Paint: Specified in Section 09 96 00 - Painting.

C. Sealant: Specified in Section 07 92 00 - Joint Sealants.

D. Bedding Compound: Type appropriate for substrate.

E. Plastic Cement: ASTM D4586, asbestos free.

2.04 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats of same material as sheet, interlockable with sheet.

C. Form pieces in longest possible lengths; profiles as shown on the Drawings.

D. Hem exposed edges on underside 1/4 (6 mm) inch; miter and seam corners.

E. Fabricate corners from one piece with minimum 6 inch long legs; miter joint shall be watertight – welded or standing seal construction. Sealing with sealant alone is not acceptable.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

G. Field fabricated copings and expansion joints shall have standing seams and continuous cleat securement in accordance with SMACNA recommendations. Lap seams and butt joints in field fabricated copings and flashings are not acceptable.

2.05 FINISH

A. Polyvinylidene Fluoride Finish: Factory-applied baked-on polyvinylidene fluoride resin finish containing not less than 70% Kynar 500 or Hylar 5000 resin, with minimum total dry film thickness of 1.0 mil (0.2 mil primer and 0.8 mil finish), in standard color as selected per approved samples.

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 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

3.03 INSTALLATION

A. Conform to drawing details for steep roofing included in the NRCA manual.

B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Section 01 45 00 - Quality Control.

B. Inspection will involve Engineer observation of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish all materials, equipment and perform all work to complete installation of all exterior caulking, including, but not necessarily limited to, the following:

1. Joints between exterior metal frames and adjacent materials.
2. Exterior joints at doors, sash, and other openings to provide air and weathertight construction.
3. Interior joints at door frames, sash and adjacent construction and other locations, as shown on the Drawings.

B. Preparing substrate surfaces.

C. Sealant and joint backing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 03 41 00 - Precast Concrete

C. Section 04 20 00 - Unit Masonry

D. Section 08 10 00 - Hollow Metal Doors and Frames

1.03 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. ASTM C509 - Elastomeric Cellular Preformed Gasket and Sealing Material.
2. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
3. ASTM C717 - Standard Terminology of Building Seals and Sealants.
4. ASTM C834 - Latex Sealants.
5. ASTM C919 - Use of Sealants in Acoustical Applications.
6. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
7. ASTM C1193 - Standard Guide for Use of Joint Sealants.
8. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

1.04 SUBMITTALS

A. Submit under provisions of Section01 33 00 - Submittal Procedures.

B. Product Data: For each joint-sealant product indicated.

C. 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.

D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

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 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.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.08 COORDINATION

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.

1.09 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.

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.

5. 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.

6. 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

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 cross cut 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 OF FINISHED WORK

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

SECTION 08 10 00
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Pressed steel hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Hollow metal window-walls, glazed openings, and other hollow metal frames for glass.

D. Rough bucks, frame reinforcing, door reinforcing, door insulation, closer reinforcements, clip angles and anchorage.

E. Factory prime paint finish.

F. Grouting of hollow metal frames with masonry mortar where not covered under other Sections.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 07 92 00 - Joint Sealants

B. Section 08 70 00 - Door Hardware

C. Section 09 96 00 - Painting

1.03 REFERENCE STANDARDS

A. ANSI/SDI100-83 - Standard Steel Doors and Frames, Steel Door Institute

B. UL 10C-98 - Fire Tests of Door Assemblies

C. NFPA 80 - Standard for Fire Doors and Windows

D. NFPA 101 - Life Safety Code

E. NFPA 105 - Standard for Smoke and Draft Control Assemblies

F. ASTM A366 - Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality

G. ASTM A568/A568M - Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled

H. ASTM A569 - Specification for Steel, Carbon, (0.15 maximum percent), Hot-Rolled Sheet and Strip Commercial Quality

I. ASTM A924/A924M - General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process

J. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100)

K. SDI 105 - Recommended Erection Instructions for Steel Frames

L. ANSI A115.1-.17 - Specification for Door and Frame Preparation for Hardware

M. ANSI A156.7 - Standard Template Hinge Dimensions

N. ASTM C236 / E-41 - Test procedures for Sound Rated (STC) Assemblies

1.04 SUBMITTALS

A. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details.

3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.

B. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage.

B. Door Storage: Store doors in upright position, under cover. Place doors on at least 4-inch-high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide 1/4-inch space between doors to promote air circulation.

C. Frame Storage: Store frames under cover on 4-inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4-inch space between frames to promote air circulation.

1.06 QUALITY ASSURANCE

A. Supplier Qualification: Qualified direct distributor of products to be furnished. The distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience who will be available at reasonable times to consult with Engineer, Owner or Contractor regarding any matters affecting the total door and frame openings.

B. Installer Qualification: Experience with installation of similar materials.

C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.

D. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.

E. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 450 degrees F maximum in 30 minutes of fire exposure.

1.07 SEQUENCING AND SCHEDULING

A. Deliver doors and frames to the jobsite in a timely manner so as not to delay progress of other trades.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Ceco Door Products; an ASSA ABLOY Group Company.
2. Curries Company; an ASSA ABLOY Group Company.
3. Pioneer Industries, Inc.
4. Steelcraft; an Ingersoll-Rand Company.

2.02 MATERIALS

A. Cold Rolled Steel Sheets: Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM A366 and A568 general requirements.

B. Galvanealed Steel Sheets: ASTM A924, A60 zinc coating. Use galvanealed steel sheets for exterior hollow metal doors, door frames and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM A569.

C. Minimum gauges of hollow metal are specified below. Provide heavier gauge if required by details or specific condition. Entire frame shall be of same gauge.

1. 16 gauge: Interior door frames
2. 16 gauge: Labeled frames
3. 18 gauge: Interior doors
4. 14 gauge: Exterior door frames
5. 16 gauge: Exterior doors
6. 20 gauge: Trim members

D. Coating Materials, primer: Use manufacturer’s standard rust inhibiting primer conforming to ANSI A224.1.

2.03 RELATED MATERIALS

A. Steel Reinforcing: ASTM A36.

B. Door Bumpers or Silencers: Per ANSI A156.16.

2.04 HOLLOW METAL FRAMES

A. General:

1. Form to profiles indicated.
2. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.

B. Typical Reinforcing:

1. Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 9 inch and lock strike reinforcement 3/16 inch by 1-1/2 inch by 4 inch long.
2. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items.
3. Provide reinforcement and clearances for concealed in-head door closers and for mortise locks.
4. Provide full height 12-gauge reinforcement for continuous hinges, spot welded to frame at 6-inch centers.

C. Reinforcement of Heads:

1. Provide continuous 7-gauge reinforcement full width of head for frames over 48 inches wide.
2. Reinforcement to be spot welded to inside of soffit at 6-inch centers.

D. Cover Plates:

1. For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.
2. Provide fully enclosed pressed steel covered boxes spot welded to the frames for power transfer, power transfer hinges, door status switches, and electromagnetic locks.
    a. Each cover box to be equipped with conduit containing wiring harness with ElectroLynx connectors at the hinge end and a bare wire end in a junction box at the head of the frame for standard connection to the building wiring.
3. Prepare frames in shop for openings listed to be equipped with door position switches by drilling a 1-inch diameter hole in the head of the frame to line up with the magnet hole in the top of the corresponding door.

E. Hardware:

1. Mortise, reinforce, drill and tap for mortise hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.

F. Anchorage:

1. Provide standard and special anchorage items as required.
2. Provide 12-gauge angle clips at bottom of frames with punched holes for securing frames to floor, except where frames are secured entirely by rough bucks. Provide formed steel channel spreader at bottom of frames, removable without damaging frame.
3. At masonry, provide anchors wire masonry anchors approximately 16 inches on center.

G. Silencers:

1. Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and one for each door at double doors.

H. Clearances:

1. Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping and smoke gasketing.
2. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16-inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant.
    a. Where sealed double glazing is indicated, provide rebates a minimum of 3/4-inch and provide 1/4-inch clearance at glass edges.
3. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.

I. Labeled Frames:

1. Construct in accordance with requirements for labeled work.

J. Joinings:

1. At frames with equal width jambs and head, neatly miter on face (except locations as at transom bars and at frames with large head members).
2. Cope and butt stops.
3. Weld length of entire joint, including face and flat intersections.

4. Grind smooth, at other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly and full weld.

5. If tight butt joints are utilized, joints shall be neatly caulked smooth.

K. Workmanship:

1. Fabricate so no grind marks, hollow or other out-of-plane areas are visible.

2. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work.

3. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.

L. Finish:

1. Clean frames by degreasing process and apply thorough coating of baked-on primer, covering inside as well as outside surfaces.

2. At galvanealed frames, coat welds and other disrupted surface with zinc-rich paint containing not less than 90 percent zinc dust by weight.

2.05 HOLLOW METAL DOORS

A. Provide to design indicated including: Flush panel doors, flush panel with cut-out as indicated. Use galvanealed steel at exterior doors.

B. Flush Doors: Reinforce, stiffen and sound deaden. Provide cut-outs for glass and louvers with stops as shown. Provide flush steel closure at top of exterior and interior doors. Provide seamless edge. Following door construction types are acceptable.

1. Exterior Doors: 16 gauge – A60 galvanized face sheets, 20-gauge steel stiffener reinforced vertically 6 inches on center, full height and width, spot welded 5 inches on center, to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.

2. Interior Doors: 18 gauge – cold rolled face sheets, 20-gauge steel stiffener reinforced vertically 6 inches on center, full height and width, spot welded 5 inches on center, to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.

C. Labeled Doors:

1. Steel stiffened core as required by Underwriters Laboratories.

2. Build in special hardware and provide astragals as indicated.

3. At one hour and at 1-1/2-hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in U.B.C. Standard No. 43-2.

D. Seamless Vertical Edges:

1. Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be tack welded, filled and sanded smooth.

E. Typical Reinforcement:

1. Provide as required for hardware items.

2. For lock reinforcement, provide manufacturer's standard reinforcement.

3. Provide 12-gauge reinforcement for escutcheons or roses.

4. Centering clips to hold lock case in alignment.
5. For door checks, provide 3/16-inch channel type reinforcements, 3-1/2-inch deep by 14 inches long, or as required.
6. Hinge reinforcement minimum 7-gauge by 1-1/2 inch by 9-inch bar. Weld reinforcing to door.
7. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops.
8. Drilling and tapping installation of these surface items shall be done in field by hardware installer.

F. Special Reinforcing:

1. At exterior doors, reinforce inside of door on hinge side with high frequency hinge preparation. Weld to door.

G. Hardware:

1. Mortise, reinforce, drill and tap for hardware furnished under Section 08 7000, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.
2. Obtain templates from hardware supplier.
3. Height of doors to correspond with thresholds and sealing systems as specified in Section 08 70 00 - Door Hardware .
4. Prepare doors for clear wire raceways to connection locations.
5. Electrified Hardware:
6. Provide doors to receive electro-mechanical function hardware with integral wire harness consisting of 15 conductors of 22-gauge wire in PVC jacket complete with ElectroLynx quick connect system to match electrified hardware.
7. Prepare doors in shop for openings listed to be equipped with door position switches by drilling a 1-inch diameter, 1-5/8 inch deep hole in the top of the door, on centerline of the thickness of the door, 6 inches from the strike side of the door.

H. Finish:

1. Provide prime coat finish on doors.
2. Thoroughly clean off rust, grease and other impurities.
3. Grind welds smooth, no marks shall show.
4. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections.
5. Sand filler coat smooth.

I. Glass and Glazing:

1. Provide U.L. Listed fire rated polished wire glass or clear tempered glass for light openings as listed on Door Schedule and shown on drawings.
2. Conform to manufacturers regulations for glazing compound in U.L. listed assemblies.

2.06 FASTENINGS

A. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship.

1. Set hollow metal plumb, level, square to proper elevations, true to line and eye.
2. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved.
3. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.
4. Placing Frames:
5. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
6. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
7. In masonry construction, building-in of anchors and grouting of frames with mortar is specified in Section 04 05 11 - Mortaring and Grouting. At in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.
8. Place fire-rated frames in accordance with NFPA 80.

B. Door Installation:

1. Fit hollow metal doors accurately in their respective frames, within following clearances:
    a. Jambs and head 3/32-inch, meeting edges pair of doors 1/8-inch, sill where no threshold or carpet 1/4-inch above finished floor, sill at threshold 3/4-inch maximum above finished floor, sill at carpet 1/4-inch above carpet.
    b. Place fire-rated doors with clearances as specified in NFPA 80.

3.03 ADJUSTING AND CLEANING

A. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08 11 50
CUSTOM STEEL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-rated and rated galvanized metal doors, reinforced for hardware.

1.02 RELATED SECTIONS

A. Section 04 05 11 - Mortaring and Grouting

B. Section 08 10 00 - Hollow Metal Doors and Frames

C. Section 08 12 13 – Custom Steel Frames

D. Section 08 70 00 - Door Hardware

E. Section 08 80 00 - Glazing

F. Section 09 96 00 - Painting

1.03 REFERENCE STANDARDS

A. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

B. ASTM A591 - Steel Sheet, Cold Rolled, Electrolytic Zinc-Coated.

C. Door Hardware Institute (DHI) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors and Builder's Hardware.

D. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames.

E. HMMA 810 - Hollow Metal Doors.

F. HMMA 830 - Hardware Preparation and Locations for Hollow Metal Doors and Frames.

G. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.

H. NFPA 80 - Fire Doors and Windows.

I. NFPA 252 - Fire Test for Door Assemblies.

J. UL 10B - Fire Tests of Door Assemblies.

K. ANSI A151.1 - Endurance Test.

L. ANSI 115 - Hardware Preparation.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.

B. Door Locations and Identification: Submit shop drawings and list the location in building and identification mark for each hollow steel door and frame. Indicate door hardware requirements. Submit manufacturer’s printed instructions covering installation of the specified work.

C. Shop Drawings: Indicate the following:

1. Elevations of each door design.
2. Details of doors including vertical and horizontal edge details.
3. Details and locations of reinforcement and preparations for hardware.
4. Details of anchorages, accessories, joints, and connections.
5. Coordination of glazing frames and stops with glass and glazing requirements.

D. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

E. Oversize Construction Certificates: For door assemblies required to be fire-protection rated and exceeding size limitations of labeled assemblies.

1.05 PERFORMANCE REQUIREMENTS

A. Conform to requirements of HMMA 802, HMMA 810, HMMA 830, HMMA 840, HMMA 850, and ANSI A117.1.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at atmospheric pressure.

2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

3. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.06 QUALIFICATIONS

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

1.07 REGULATORY REQUIREMENTS

A. Fire Rated Door Construction: Conform to ASTM E152.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Wrap, carton, and crate as required to provide physical and climatic protection during loading, shipping and job site storage and handling.

B. Deliver packaged materials to the project site in the manufacturer's original, unopened containers which bear intact, legible and visible labels that identify the manufacturer's name and brand name, the contents, grade and type.

C. Upon delivery, immediately inspect shipments to assure their compliance with the requirements of the Contract Documents and approved submittals, and that products are complete, undamaged and adequately protected. Immediately report damaged, missing, or defective items. Remove broken, damaged or unlabeled items from the site immediately.

D. Store doors and frames at building site under cover. Place units on minimum 4 inch high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4 inch spaces between stacked doors to promote air circulation.

E. Store products in accordance with manufacturer's instructions with seals and labels intact, legible, and visible. Store products in a manner to prevent damage, soiling, theft, deterioration and contamination. Marred surfaces, cracked, checked split or warped materials will be rejected. Store materials subject to damage by climatic conditions in weather tight enclosures. Maintain temperature and humidity within the ranges required or recommended by the manufacturer.

F. Repair or clean items that have been damaged or soiled that can be restored to an "as new" condition at no cost to the Owner. The Owner's Representative shall be the judge of the effectiveness of remedial measures. Additional time or expenses required to secure

replacements and to make repairs will not be considered by the Owner's Representative to justify an extension in the Contract time of completion or an increase in the Contract amount.

1.09 FIELD MEASUREMENTS

A. Field measure openings prior to fabrication of doors.

B. Verify that field measurements are as indicated on the shop drawings.

C. Coordinate the work with door opening construction, door frame and door hardware installation.

PART 2 PRODUCTS

2.01 DOOR MANUFACTURERS

A. CECO: Product - Medallion Series.

B. Substitutions: Under provisions of the Specifications.

1. Substitution must meet the gage and galvanizing specification requirements.

2. Doors shall be from the same manufacturer as the hollow metal frames.

2.02 DOORS

A. Doors (Rated and Non-rated): Flush seamless doors with glass inserts as indicated on the Drawings.

2.03 DOOR CONSTRUCTION

A. Face: Steel, 16 gage, galvanized sheet in accordance with ASTM A653, G90, galvanized both sides; manufactured and fabricated in accordance with HMMA 802 and 810.

B. 22 gage stiffeners spaced at 6" internally on the door, welded to the face sheets at 5" on center.

C. Core: Fiberglass insulation to limit thermal and sound transmission.

D. Door Edge Design: 1/8 inch in 2 inch bevel for lock edge; hinge side shall be square.

E. Door Edge Seam: Doors shall have vertical, interlocking, continuous mechanical joints at lock and hinge side with edge seam filled and ground smooth to provide a seamless appearance. The internal portion of the seam shall be sealed with epoxy.

F. Glass moldings and stops:

1. Where indicated on the Drawings doors shall be provided with steel moldings to secure glazing by others in accordance with the glass sizes and thickness indicated and specified.

2. Fixed glass moldings shall be welded to the exterior side (secure side) of the door.

3. Removable glass stops shall be channels that are a minimum 20 gage with tight fitting corners and secured with shall be secured with countersunk philips head machine screws; provide a minimum of two screws per each length of molding; where length is more than 18 inches long, provide additional screw anchorage at not over 12 inches on center. Moldings shall be mounted flush into the door or frame without overlapping the door or frame face sheet.

4. All metal surfaces shall be galvanized similar to the door and finished to match the door primer as shipped from the factory.

2.04 FABRICATION

A. Fabricate doors with galvanized hardware reinforcement welded in place. Prepare doors to receive mortised hardware unless noted otherwise in Section 08 70 00 - Door Hardware.

B. Fabricate fire doors to UL requirements for labeling as designated in the Door Schedule on the Drawings. Attach fire rated label to each door unit.

C. Close top and bottom edge of all doors with inverted steel channel. Weld all seams watertight. Top of door shall be flush – provide optional top cap to close inverted top channel.

D. Mortise all exterior doors for 2 pair hinges.

E. Mortise all interior doors for 1-1/2 pair hinges.

F. Fabricate doors with hardware reinforcement plates projection welded in place. All reinforcing shall be G90 galvanized. Minimum reinforcing gages:

1. Hinge reinforcements: 7 gage minimum.
2. Lock reinforcements: 16 gage minimum.
3. Closer reinforcement: 14 gage box minimum.

G. Provide adequate reinforcing for all other hardware as may be specified.

2.05 FINISH

A. Doors: ASTM A653 G90 galvanizing.

B. Primer: Shop applied, baked on, rust inhibited paint, compatible with galvanized surfaces.

C. Shop primer shall be compatible with finish coats applied in the field.

D. Doors and transom panel shall be field painted as specified in Section 09 96 00 - Painting; color shall be as selected by the Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate conditions are ready to receive work.

B. Verify that opening sizes and tolerances are acceptable.

3.02 INSTALLATION

A. Install doors in accordance with HMMA 840 and HMMA 830 DHI for hardware installation.

B. Assemble door hardware, place accurately and attach securely to the doors and frames.

C. Hang doors to fit closely in frames without binding; to be in full contact with stops at all points when closed; to swing easily and quietly, without striking the floor at any point of the swing; and to remain in any position left between opened and closed without moving. Exterior doors shall be weathertight when closed.

D. Fit doors accurately in frames, within clearances specified in ANSI A250.8.

E. Thermal insulated door perimeter seals shall be adjusted for proper operation.

F. Coordinate installation of glass and glazing.

G. Coordinate installation of doors with installation of frames specified in Section 08 12 13 - Custom Steel Frames and hardware specified in Section 08 70 00 - Door Hardware.

3.03 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 FIELD QUALITY CONTROL

A. After doors are installed, test-demonstrate in the presence of the Owner's Representative that the doors operate properly under all conditions. Adjust doors and door hardware if tests show improper functioning.

B. Adjust door for smooth and balanced door movement.

C. Prime Coat Touch-up: Immediately after installation, sand smooth any rested or damaged areas of prime coat and apply touch up of compatible air-drying primer.

D. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08 12 13
CUSTOM STEEL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rated and non-rated galvanized, reinforced steel frames for hollow metal doors.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 04 20 00 - Unit Masonry: Placement of anchors into wall construction.

1.03 RELATED SECTIONS

A. Section 04 05 11 - Mortaring and Grouting

B. Section 08 11 50 - Custom Steel Doors

C. Section 08 70 00 - Door Hardware

D. Section 08 80 00 - Glazing

E. Section 09 96 00 - Painting

1.04 REFERENCE STANDARDS

A. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

B. DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

C. HMMA 802 - Manufacturing of Hollow Metal Doors and Frames.

D. HMMA 820 - Hollow Metal Frames.

E. HMMA 830 - Hardware Preparation and Locations for Hollow Metal Doors and Frames.

F. HMMA 840 - Installation and Storage of Hollow Metal Doors and Frames.

G. HMMA 850 - Fire Rated Hollow Metal Doors and Frames.

H. NFPA 80 - Fire Doors and Windows.

I. NFPA 252 - Fire Tests for Door Assemblies.

J. UL 10B - Fire Tests of Door Assemblies.

1.05 SUBMITTALS

A. Shop Drawings: Indicate frame elevations, reinforcement, construction and finish. Provide details for removable hollow metal transom at transom panel.

B. Shop Drawings: Indicate the following:

1. Details of doors including vertical and horizontal edge details.
2. Frame details for each frame type including dimensioned profiles.
3. Details and locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of anchorages, accessories, joints, and connections.

C. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Conform to requirements of HMMA 802, HMMA 820, HMMA 830, HMMA 840, HMMA 850, SDI 100, ANSI A117.1 and ANSI A151.1.

B. A physical label or approved marking shall be affixed to fire door rated frames at an authorized facility as evidence of compliance with procedures of the labeling agency.

1.07 QUALIFICATIONS

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

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site in accordance with the manufacturer's instructions.

B. Protect frames with resilient packaging sealed with heat shrunk plastic.

C. Break seal on-site to permit ventilation. If moisture appears under the shipping wrapper, remove wrapper, vent to dry and recover, allowing air to circulate around frames.

D. Store frames upright, under cover, on 4 inch wood sills set on floors in a manner to prevent rust and damage. Provide a 1/4 inch space between frames to promote air circulation.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the shop drawings.

1.10 COORDINATION

A. Coordinate work under provisions of Section 01 31 19 - Project Meetings.

B. Coordinate the work with frame opening construction, door and hardware installation.

PART 2 PRODUCTS

2.01 FRAME MANUFACTURERS

A. CECO

B. Substitutions: Under provisions of the Specifications.

1. Substitutions must meet the gage and galvanizing specification requirements.

2. Frames shall be from the same manufacturer as the hollow metal doors.

2.02 FRAMES

A. Steel: G90 Galvanized sheet in accordance with ASTM A653.

B. Frames: 14 gage thick material, core thickness.

2.03 ACCESSORIES

A. Silencers: Resilient rubber fitted into drilled hole are required on all interior frames.

B. Bituminous Coating: Fibered asphalt emulsion.

C. Primer: Zinc chromate.

D. Masonry jamb anchors shall be galvanized strap anchors; wire anchors are not permitted. Anchors shall be perforated to aid in the mortaring solid of frames.

1. UL requirements indicate the strap anchors must be welded in place.

a. Coordinate placement with masonry coursing.

b. Touch-up galvanized coating damaged from welding prior to back-coating of frame.

E. Where frames are to be installed in concrete walls or existing masonry walls, provide countersunk expansion anchor bolts (4 per jamb) to secure frame.

1. Anchor bolt heads shall be glazed over with epoxy, flush and smooth with frame surface, primed and finish painted to match frame.

F. Provide adjustable jamb base anchors for each frame.

2.04 FABRICATION

A. Fabricate frames to HMMA 802 and 820, style and configuration to suit doors specified in Section 08114.

B. Fabricate frames with 2 inch jamb face and 2 inch head (unless noted otherwise on the Drawings); frames shall be set-up and arc welded with corner welds ground smooth.

C. Mortise all exterior frames for 2 pairs of hinges.

D. Mortise all interior frames for 1-1/2 pairs of hinges.

E. Fabricate frames with hardware reinforcement plates projection welded in place. All reinforcing shall be G90 galvanized. Minimum reinforcing gages:

1. Strike reinforcement: 16 gage
2. Hinge reinforcements: 8 gage
3. Lock reinforcements: 16 gage
4. Closer reinforcement: 14 gage

F. Provide adequate reinforcing for all other hardware as may be specified.

G. Provide mortar guard boxes.

H. Prepare interior door frames for silencers. Provide three single silencers for single doors on strike side.

I. Fabricate frames for heights as shown on the Drawings.

2.05 FINISH

A. Interior and Exterior Units: ASTM A653 G90.

B. Primer: One coat, baked on, rust inhibiting paint in accordance with ANSI A224.1.

C. Coat inside of frame profile with bituminous coating to a thickness of 1/16 inch (1.5 mm).

PART 3 EXECUTION

A. Verify substrate conditions under provisions of Section 01 31 19 - Project Meetings.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that frames have proper interior coating.

3.02 INSTALLATION

A. Deliver frames to the Project Site for installation. Coordinate delivery staging area. Protect until installation.

B. Install frames in accordance with HMMA 840 and HMMA 830.

C. Install frames into new masonry walls using masonry strap anchors, minimum of 3 anchors per jamb for a standard pedestrian door (7’0” high). Provide additional anchors for taller doors to maintain a maximum spacing of 2’-0” between anchors.

D. Install frames in concrete walls or existing masonry walls. Bolt the hollow steel frames to the wall opening edges with the “existing wall anchor assemblies”. Provide one assembly each at top and bottom of jamb, not over eight inches away from end and at not over 2 feet between end assemblies, in each jamb. Countersink bolt heads to be flush with the face of the stops, through sleeved spacers behind the stops.

E. Install frames at structural channel or plate rough openings by welding the frames to the rough opening steel. At each jamb**,** use four 2-inch long fillet welds at each face of frame (total of 16 welds). At head, use three 2-inch long fillet welds at each face of frame (total of 6 welds).

F. Install Fire-Rated frames in accordance with NFPA Standard No. 80, and with the requirements of the Owner's Underwriters or the Rating Bureau, as appropriate. Install frames so that when doors are in the closed position, there are no corner or edge gaps between door and frame.

G. Comply with provisions of SDI-105-92 "Recommended Erection Instructions for Steel Frames", unless otherwise shown.

H. Mortar frames solid.

I. Coordinate installation of glass and glazing.

J. Coordinate installation of frames with installation of hardware specified in Section 08 12 13 - Custom Steel Frames and Section 08 70 00 - Door Hardware.

K. Maximum Diagonal Distortion: 1/16 inch (1.5 mm) measured with straight edges, crossed corner to corner.

END OF SECTION

SECTION 08 31 13
ACCESS HATCHES

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. Access hatches shall be of single- or double-cover construction of the size and as shown on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

1.03 SUBMITTALS

A. Shop Drawings:

1. Drawings for fabrication and installation of all floor, pit, and sidewalk doors and frames, including details of each frame type, elevations of door design types, anchorage, and accessory items.

2. Product Data: Submit manufacturer's technical data and installation instructions for each type of access hatched assembly, including setting drawings, templates, and instructions and directions for installation of anchorage devices.

   a. Include complete schedule including types, general locations, sizes, floor, pit, and sidewalk construction details, finishes, hardware information, latching or locking provisions, and other data pertinent to installation.

3. Verification: Obtain specific locations and sizes for access hatches from trades and manufacturers requiring access to equipment, and indicate on Submittal Schedule.

4. Special Size and Load Floor, Pit, and Sidewalk Doors: Use where required or requested as indicated on Drawing Schedule.

5. Samples: 3 inches by 5 inches minimum size, of each cover face material showing factory finished color, pattern, and texture.

B. Submittals Sequence: Submit Schedule, Product Data, and Shop Drawings at earliest possible date, particularly where acceptance must precede fabrication of other work (e.g., concrete work) which is critical in the Project Construction Schedule. Include the product data, samples, Shop Drawings of other work affected by access hatches, and other information essential to the coordinated review of same.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide access hatches, frames, hardware, and related items produced by a single manufacturer capable of showing prior production of floor access hatches assemblies similar to those required.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.

C. Size Variations: Obtain Engineer's acceptance of manufacturer's standard size units which may vary slightly from sizes indicated.

D. Coordination: Provide inserts and anchoring devices which must be built into other Work for installation of access hatches. Coordinate delivery with other Work to avoid delay.

1.05 PROJECT CONDITIONS

A. Field Measurement: Where possible, field measure openings before fabrication to ensure proper fit of work; show measurements on final Shop Drawings. Coordinate fabrication with

construction progress to avoid delay. If necessary, proceed with fabrication without measurements, and coordinate tolerances to ensure proper fit.

1.06 WARRANTIES

A. Special Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace components or entire units which fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to, structural failure including excessive deflection, excessive water leakage, faulty operation of hardware, deterioration of metals, metal finishes and other materials beyond normal weathering.

1. Warranty period for access hatch units shall be 5 years after the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Bilco
2. Halliday
3. USF Fabrication

2.02 MATERIALS

A. Provide each access hatch assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Aluminum access hatches and frames: Fabricate units of continuous welded aluminum construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure frames to types of floor or walkway shown on Drawings.

C. Covers: Covers shall be mill finish aluminum 1/4-inch diamond pattern, reinforced on the underside. Covers shall open to 90 degrees and lock automatically in that position.

D. Channel Frame: Channel frame shall be 1/4-inch extruded aluminum with bituminous coating applied to the exterior of the frame and with full anchor flange and welded anchors for concrete installation around the perimeter.

E. For watertightness, furnish frame with formed gutters a minimum of 3-inch wide by 3-inch deep, anchors, and a welded 1-1/2-inch drain coupling located on the right front corner of the channel frame or in another corner if shown on Drawings or specified otherwise. Fully weld gutter frame for absolute weathertightness.

F. Hinges, Pins, Bolts, and Nuts: Provide the covers with heavy 12 gauge, No. 316 stainless steel hinges and stainless steel pins. Hinges shall pivot so the cover does not protrude into channel frame. Hinges shall be through-bolted to the cover with stainless steel lock bolts and shall be through-bolted to the frame with stainless steel bolts and lock nuts.

G. Springs, Tubes, Shoes, Plates, Enclosures, and Operators: Provide the covers with manufacturer's standard springs, tubes and caps, tube or spring enclosures, operators, support plates, and shoes, which shall allow ease of operation through the entire 90-degree arc of opening, and act as a check in retarding downward motion when being closed. Tube and spring enclosures shall prevent accumulation of moisture, grit, and debris inside the tube and spring assembly.

H. Hold-Open Arms: Provide the covers with hold-open arms with guides which automatically lock the covers in the open position. Vinyl covered release handles shall be provided and conveniently located for closing.

I. Interior Snap Lock and Lock Strike: Provide a stainless steel snap lock and lock strike with a stainless steel fixed turn handle and appropriate stainless steel bolts mounted on the underside of the covers.

J. Exterior Lift Handle: Provide the covers with a stainless steel lift handle designed to be flush with walking surface when not in use.

K. Locking and Latching Devices: Provide the covers with the following locking or latching device and related hinged lid, flush gasketed removable screw plug, or threaded cover plug as noted:

L. Interior access hatches shall have removable exterior latch handle with plug: Provide removable exterior stainless steel latch handle and latch release protected by a flush gasketed removable screw plug.

M. Exterior access hatches shall have cylinder lock: Provide a brass cylinder lock with keyway protected by a threaded cover plug. Equip lock with cylinder and keys as specified.

N. Hardware Finish: Except where noted otherwise, all hardware shall be zinc plated and chromate sealed.

2.03 ACCESSORIES

A. Provide ladder safety posts at fixed ladders and manhole rungs located below access hatches. Safety posts shall be designed with telescoping section that locks automatically when fully extended. Up and down movement shall be controlled by a stainless steel spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to ladder rungs in accordance with manufacturer’s instructions. Finish to match ladder served.

1. Safety post shall be Bilco Ladder Up or approved equal.

B. Provide fall prevention device below floor doors. The fall prevention device shall be permanently installed fall-through prevention system that is easily retractable for full access and allows visibility for inspection. The product must be FRP or stainless steel Type 316. Grating shall have a live load capacity of 100 pounds per square foot.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's instructions for installation of floor, pit, and sidewalk doors.

B. Preparatory Work: For normal flush installation, set frames accurately in position, recessed below the finished grade or floor level with cover face panels plumb or level in relationship to adjacent finish surfaces. If unit is watertight type, unit should be set with slight pitch in direction of drain coupling. All four corners of the frame shall be in the same plane; verify that leaves are seated properly on frame all around. Securely attach units to supports.

C. Method: For flush installation, pour concrete to top of frame. Aluminum surfaces in contact with concrete shall be coated with a bituminous coating prior to installation.

D. Coordinate installation with Work of other trades.

3.02 ADJUSTING AND CLEANING

A. Adjust hardware and covers after installation for proper operation.

B. Remove and replace covers or frames which are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 33 23
OVERHEAD DOORS

PART 1 GENERAL

1.01 SCOPE OF WORK

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. Note the Building interior is classified as Class I, Division 1, Group D environment.
3. Coiling Door: Surface mounted, explosion proof operator & controls.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 05 50 00 - Metal Fabrications

B. Division 26 - Electrical

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.

C. Unit shall be designed with Explosion Proof features compatible with NEMA Class 1 Group D construction.

1.06 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 - 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. Refer to Section 01 77 00 - 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).

a. Raynor Garage Doors, Model DuraCoil Optima.

b. Wayne Dalton, Model 800C.

c. Substitutions: Section 01600 - Product Requirements.

2.02 COMPONENTS

A. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.

B. 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. Windlocks shall be attached to a minimum of every 6th slat.

2. Front slat fabricated of:

a. 20 gauge stainless steel.

3. Back slat fabricated of:

a. 24 gauge stainless steel.

4. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation.

5. R-Value: 7.7, U-Value: 0.13.

6. Sound Rating: STC-21.

C. Performance:

1. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.

2. Installed System Sound Rating: STC-21 as per ASTM E 90.

3. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.

4. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft2.

D. Slats and Hood Finish:

1. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process.

2. Powder Coat:

a. PowderGuard Premium powder coat color as selected by the Architect.

E. Weatherseals:

1. Vinyl bottom seal, exterior guide and internal hood seals.

2. Interior guide weatherseal.

F. Bottom Bar:

1. Two galvanized steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.

G. Guides: Three structural steel angles.

H. Brackets:

1. Hot rolled prime painted steel to support counterbalance, curtain and hood.

I. Finish; Bottom Bar, Guides, Headplate and Brackets:

1. Finish: PowderGuard Zinc base coat, gray with PowderGuard Premium powder coat color as selected by the Architect.

J. 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.

K. Hood: Provide with internal hood baffle weatherseal.

1. 24 gauge galvanized steel with intermediate supports as required.

L. 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.

1. Sensing Edge Protection:
2. Electric sensing edge.
    a. Operator Controls:
    b. Push-button operated control stations with open, close, and stop buttons.
    c. Controls for interior location.
    d. Controls surface mounted.
3. Motor Voltage: 115/230 single phase, 60 Hz.
4. Windload Design:
    a. Standard windload shall be 20 PSF.

M. Locking:

1. Chain keeper locks for chain hoist operation.

N. Wall Mounting Condition:

1. Face-of-wall mounting.

O. 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.

P. 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.

Q. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.

R. Hardware: Door shall be fitted with a roller chain and sprocket operator for emergency operation.

S. Weatherstripping (Exterior Assemblies): Moisture and rot proof, resilient type for complete weathertight installation.

T. 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. Operator

1. Description: UL 325 2010 compliant, side mounted, totally enclosed, non-ventilated.
2. Model: Overhead Door RHX or equal
3. Motor Enclosure: NEMA Class 1 Group D Explosion Proof enclosure. (Edit if not x-proof required)
4. Motor Rating: minimum 3/4 hp; continuous duty.
5. Motor Voltage: 230/460 volt, three phase, 60 Hz.
6. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
7. Controller Enclosure: NEMA 7 (or specify 4, 4X, etc.)
8. Brake: Adjustable friction clutch type, activated by motor controller.

B. Control Station: Standard three button Open-Stop-Close momentary control for operator; 24 volt circuit; surface mounted, NEMA 4 intrinsically safe.

C. Motor, wiring and all controls shall meet NEMA Class 1 Group D Explosion Proof construction requirements.

D. Provide adjustable limit switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions with NEMA 4 or NEMA 7, Class I, Division 1, group D enclosures as applicable.

E. All 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 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. Install fire rated door assemblies in accordance with NFPA 80 and requirements for fire listing.

E. Coordinate installation of electrical service with Division 16. Complete wiring from disconnect to unit components and from fire alarm system to door operator.

F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900.

G. Install perimeter trim and closures.

3.02 TOLERANCES

A. Section 01 45 00 - Quality Control: 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.

3.03 ADJUSTING

A. Section 01 77 00 - Closeout Procedures: Testing, adjusting, and balancing.

B. Adjust door, hardware and operating assemblies for smooth and noiseless operation.

C. Test smoke activated assemblies for proper activation.

3.04 CLEANING

A. Section 01 77 00 - Closeout Procedures: Final cleaning.

B. Clean door and components.

C. Remove labels and visible markings.

END OF SECTION

SECTION 08 70 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Hardware for doors.

B. Thresholds.

C. Weatherstripping, seals and door gaskets.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 77 00 - Closeout Procedures

B. Section 08 11 50 - Custom Steel Doors

C. Section 08 12 13 - Custom Steel Frames

D. Section 08 31 13 - Access Hatches

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 33 00 - 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. All necessary templates and schedules shall be provided at such time so not to delay the Work. Refer to Delivery, Storage and Handling herein for forwarding requirements of hardware.

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 77 00 - 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 77 00 - 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 60 00 - Product Requirements.

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 work under provisions of Section 01 31 19 - Project Meetings.

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

1.12 WARRANTY

A. Provide five-year warranty under provisions of Section 01 77 00 - Closeout Procedures.

B. Warranty: Include coverage for door closers.

1.13 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of Section 01 77 00 - 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 DOORS

A. General:

1. The following description of designated hardware components is limited to elements that are established as constants throughout the project and are not intended to be complete.

2. When a description is coupled with criteria established under the heading "Hardware Sets," the hardware for a particular opening will be complete to the extent necessary for a satisfactory installation.

3. The descriptions contain "Key Words" which when used in the hardware sets in conjunction with other notations, will establish the hardware elements assigned to the individual door.

2.02 HINGES

A. Stainless steel with ball bearings, flat button tip, Stanley FBB 191 32D, Hanger BB 1191 or McKinney No. TB2314.

B. Hinges shall be 4-1/2" x 4-1/2" minimum .134 inches thick stainless steel with stainless steel pins.

C. Interior doors shall have a minimum of 1 1/2 pair per leaf, (U.N.O.); exterior doors shall have 2 pair, non-removable pins (NRP).

2.03 MORTISE LOCKS

A. Corbin/Russwin ML2200 series hardware, for severe climatic conditions or marine use with all stainless steel and bronze construction to resist corrosion, including non-ferrous or stainless steel case.

B. Cylinder locks or unlocks outside lever. Inside lever always free for egress.

C. Minimum 3/4-inch latch bolt throw designed to accept 1-5/32-inch diameter standard cam cylinder and adjustable from flat front to standard bevel either hand.

2.04 LEVERS AND ESCUTCHEONS

A. Levers shall be cast stainless steel; escutcheons shall be wrought stainless steel.

B. Each lockset set shall be furnished complete with one pair of levers and escutcheons. Model shall be Corbin/Russwin "ASP".

2.05 EXIT DEVICES

A. US-26D smooth case with stainless steel touch bar and lever trim, mortised cylinder recess, Von Duprin, No. 9875L x 07 lever designed for exterior doors.

B. Interior doors do not require cylinders unless noted in the hardware sets below.

C. Provide blank escutcheons for these locations, trim shall always be operable.

D. Provide matching Von Duprin 98 Series UL labeled device for fire rated doors.

E. Strikes shall be stainless steel, dustproof; coordinate with exit devices, as required

F. Hex key dogging is acceptable.

2.06 CLOSERS

A. Surface mounted closer with cast iron cylinder, adjustable back check, and spring power with key valve adjusting screws for closing and latching speeds and back check control.

B. Closer arms shall allow for minimum 100-degree swing.

C. Closers shall be LCN Smoothee Series, resistant to severe climatic conditions with a U.S.-26D sprayed finish on covers.

D. Provide SRI finish on closer bodies and arms.

E. Closers:

1. For pull side mounting: LCN 4011DA

2. For push side mounting: LCN 4111DA

2.07 KICKPLATES

A. Dull stainless steel (US32D), (.050) gage 10-inch high except at doors with narrow bottom stiles where the height shall be reduced to 1/2-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.

B. Mount kickplates flush with lock style edge of pairs of doors.

C. Provide kickplates push side of all hollow metal doors.

D. 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.

E. Finish shall be aluminum mill finish.

F. Provide one threshold for each exterior door opening.

2.08 WEATHERSTRIPPING

A. National Guard Products, Reese, Zero or Pemco. Model No. listed are National Guard Products (NPG).

B. Head and jambs, NPG No. 160VA vinyl; door bottom seal, NPG 312, vinyl (1/2-inch); Finish for weatherstripping shall be natural satin anodized aluminum.

C. Provide weatherstrip for all exterior doors.

2.09 FLUSH BOLTS

A. Manual type, Glynn Johnson No. FB6 x US26D, one each top and bottom, spring loaded, forged brass construction with DP2.

2.10 OVERHEAD HOLDERS

A. Glynn Johnson No. 814H-US32D-SOC, stainless steel.

2.11 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
2. 4 master keys

2.12 FINISHES

A. Satin chrome, U.S. 32D or 26D, when U.S. 32D is not available, unless otherwise noted in hardware product descriptions.

B. 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 45 00 - Quality Control.

B. Architectural Hardware

C. Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

D. Contractor shall submit a letter from the Architectural Hardware Consultant certify the installation.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 77 00 - Closeout Procedures.

B. Adjust hardware for smooth operation.

3.05 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00 - Temporary Facilities and Controls.

B. Do not permit adjacent work to damage hardware or finish.

3.06 SCHEDULE

A. Set 01:

Hinge - 2 Pair	Closer	Kickplate	Lock Protector
Threshold	Weatherstripping	Exit Device - Mortise lockset with Entrance Function	

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide labor, material and equipment to furnish and install glass and glazing accessories for:

1. Steel, aluminum, or wood doors and frames.

2. Manufactured fixed and operable aluminum windows.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08 10 00 - Hollow Metal Doors and Frames

1.03 REFERENCE STANDARDS

A. AAMA 800 - Voluntary Specifications and Test Methods for Sealants.

B. ANSI Z97.1 - Safety Glazing Material Used in Buildings- Safety Performance Specification and Method of Test R.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM C509 - Elastomeric Cellular Preformed Gasket and Sealing Material.

E. ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

F. ASTM C920 - Elastomeric Joint Sealants.

G. ASTM C1036 - Flat Glass.

H. ASTM C1048 - Heat Treated Flat Glass, Kind HS, Kind FT, Coated and Uncoated.

I. ASTM C1115 - Dense Elastomeric Silicone Rubber Gaskets and Accessories.

J. ASTM C1172 - Laminated Architectural Flat Glass.

K. ASTM C1281 - Preformed Tape Sealants for Glazing Applications.

L. ASTM E546 - Frost Point of Sealed Insulating Glass Units.

M. ASTM E576 - Frost Point of Sealed Insulating Glass Units in Vertical Position.

N. ASTM E773 - Accelerated Weathering of Sealed Insulating Glass Units.

O. ASTM E774 - Classification of the Durability of Sealed Insulating Glass Units.

P. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

Q. ASTM E2010 - Test Method for Positive Pressure Fire Tests of Window Assemblies.

R. 16 CFR 1201 CFR 16CFR 1201 - Safety Standard for Architectural Glazing Materials.

S. GANA (GM) GANA - Glazing Manual.

1.04 DEFINITIONS

A. Visible Light Transmittance (T-vis): Percentage of sun's visible energy transmitted through glass.

B. Ultraviolet Transmittance: Percentage of sun's ultra violet or infrared energy transmitted through glass.

C. U-value: Overall indication of heat flow through glass where a lower value indicates less heat flow and hence better thermal performance. Winter nighttime values are calculated using outdoor air temperature of 0 degrees Fahrenheit, indoor temperature of 70 degrees Fahrenheit,

and 15 MPH outdoor air velocity. Summer daytime U-values are calculated using outdoor air temperature of 89 degrees Fahrenheit, indoor temperature of 75 degrees Fahrenheit, 7.5 MPH outdoor air velocity, and solar intensity of 248 BTU.

D. Shading Coefficient (SC): Ratio of total solar energy passing through glass relative to amount passing through 1/8 inch thick clear glass under same conditions. A lower coefficient indicates better performance in reducing heat gain.

E. Solar Heat Gain Coefficient (SHGC): Solar heat gain through glass relative to the amount of solar radiation. It is equal to 86 percent of the shading coefficient.

F. Light-to-Solar Gain Ratio (LSG): Ratio of visible light transmittance (T-vis) to solar heat gain coefficient (SHGC), LSG=(T-vis)/(SHGC). The higher the ratio, the better the glass is at reducing unwanted solar heat and maximizing light transmittance.

1.05 SUBMITTALS

A. Shop Drawings and Product Data:

1. List of proposed products and product data.
2. Glazing schedule, including glass type, size, and thickness for each opening. Shop drawings detailing glass setting methods and materials.
3. Glass manufacturer, glass fabricator, and installer qualifications.
4. Manufacturer's certificates that:
    a. Glazing materials meet or exceed specified requirements.
    b. Sealants have been tested for adhesion to and compatibility with glass and glazing substrates.
5. Fabricator’s certificates: Certify that safety glass units and sealed insulating glass units meet or exceed specified requirements.
6. Manufacturer's installation and protection instructions.
7. Copy of warranties for review by Engineer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect glass and glazing materials during delivery, storage, and handling in accordance with manufacturer's instructions.

B. Prevent edging chipping and damage from condensation, temperature changes, and exposure to sunlight.

C. Insulating glass units: Comply with fabricator's instructions for venting and sealing when units are exposed to substantial altitude changes.

1.07 QUALITY ASSURANCE

A. Glass manufacturer: Company specializing in manufacture of clear, tinted, coated, and other glass products with 10 years minimum successful experience.

B. Source quality control: To ensure uniformity, all tinted and coated glass used for Project shall be obtained from single manufacturer.

C. Glass fabricator: Company specialized in fabricating insulating, heat strengthened, tempered, laminated, glass units with 5 years minimum successful experience.

D. Glass installer: Company installing glass on site shall specialize in this type of work and have 5 years minimum successful experience.

E. Safety glazing: Comply with 16 CFR 1201, ANSI Z97.1, and other applicable safety requirements. Each piece of safety glazing shall be permanently labeled with appropriate marking.

1.08 SYSTEM DESCRIPTION

A. Provide and install glass in accordance ASTM E1300 to withstand thermal movement and wind and impact loads without breakage, loss, failure of seals, product deterioration, and other defects.

1. Wind and snow design loads: Determined by ASCE 7.
2. Thermal movement design conditions:
    a. Ambient temperature range: 120 degrees Fahrenheit (48.8 degrees Celsius).
    b. Material surfaces range: 180 degrees Fahrenheit (82.2 degrees Celsius).
3. Provide and install gaskets, sealants, and other glazing accessories to resist water and air penetration.
4. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program or latest version, expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
5. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program or latest version.
6. Solar and Infrared Optical Properties: NFRC 300.

1.09 COORDINATION

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

1.10 WARRANTY

A. Provide the following warranties, as necessary, under provisions of Section 01 77 00 - Closeout Procedures:

1. Coated glass units: Ten (10) years manufacturer's warranty to cover replacement in event of peeling, cracking, and deterioration of coating.
2. Insulating sealed glass units: Ten (10) years fabricator's warranty to cover replacement in event of seal failure and interpane dusting, misting, and filming.
3. Laminated glass units: Five (5) years fabricator's warranty to cover replacement in event of delamination, edge separation, and blemishes exceeding referenced standard.
4. Mirror glass units: Five (5) years manufacturer's warranty to cover replacement in event of peeling, cracking, and deterioration of coating.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers of equivalent products shall be submitted and approved in accordance with Section 01 33 00 - Submittal Procedures. Engineer reserves right to reject proposed substitutions on basis of color tint and reflective appearance even though material and performance values are equivalent.

2.02 PRIMARY GLASS PRODUCTS

A. Clear Glass:

1. Type: Clear, transparent, flat, annealed, float glass, conforming to ASTM C1036, Type I, Class 1, Quality q3.
2. Thickness: 1/4-inch

3. Performance attributes:
    a. Ultraviolet Transmittance: 65 percent.
    b. Winter Nighttime U-value: 1.09
    c. Summer Daytime U-value: 1.03
    d. Shading Coefficient (SC): 0.94
    e. Solar Heat Gain Coefficient (SHGC): 0.81
    f. Light-to-Solar Gain Ratio (LSG): 1.10

B. Low Emissivity (Low-E) Glass:
1. Type: Clear glass with neutral coating pyrolytically applied to produce durable surface with unlimited shelf life and product which can be easily cut and tempered and resulting in improved thermal performance and reduced solar heat gain.
2. Thickness: 1/4 inch
3. Performance attributes:
    a. Visible Light Transmittance (T-vis): 0.44 minimum
    b. Winter Nighttime U-value: 0.35 maximum
    c. Summer Daytime U-value: 0.36 maximum
    d. Light-to-Solar Gain Ration (LSG): 1.15 minimum
    e. Solar Heat Gain Coefficient (SHGC): As appropriate to comply with above requirements for T-vis and LSG

C. Wired Glass:
1. Type: Clear, annealed, flat glass, conforming to ASTM C1036, Type II, Class 1, Quality q8. Glass for fire-rated doors shall comply with NFPA 80, ASTM 2010 and UL 9, labeled and listed by UL or other testing and inspecting agency.
2. Surface: Form 1, polished both sides.
3. Thickness: 1/4 inch
4. Mesh: Woven stainless steel wire in diamond mesh pattern.

2.03 HEAT TREATED GLASS

A. Heat Strengthened Glass: Provide heat strengthened, annealed glass components where indicated or required to adequately support imposed loads, to allow for large glass size, and resist anticipated thermal stresses in accordance with ASTM C1048, Kind HS.

B. Fully Tempered Glass:
1. Provide heat tempered, annealed glass components where indicated or required to adequately resist loading conditions, size of units, and anticipated thermal stresses in accordance with ASTM C1048, Kind FT.
2. Fully tempered glass shall meet requirements of ANSI Z97.1 and 16 CFR 1201 to qualify as safety glass.

2.04 LAMINATED GLASS

A. Laminated Glass: Fabricate by bonding two or more glass panes with transparent, flexible interlayment material in accordance with ASTM C1172.

B. Laminated glass shall meet requirements of ANSI Z97.1 and 16 CFR 1201 to qualify as safety glass.

2.05 ACCESSORIES

A. Provide glazing accessories for specific applications of type recommended by glass manufacturer and glass fabricator and as required for complete, functional, weather tight installation.

B. Cleaners and primers: Compatible with substrate and glazing materials and application condition.

C. Setting blocks: Elastomeric material with Shore A durometer hardness between 80 and 90.

D. Spacer shims: Elastomeric material blocks or extrusions with 50 to 60 Shore A durometer hardness.

E. Edge blocks: Elastomeric material of hardness required to limit lateral movement of glass.

F. Glazing tape: Preformed butyl compound, non-staining, non-migrating in contact with non-porous surfaces, coiled on release paper, black and complying with ASTM C1281 and AAMA 800.

G. Glazing gaskets: Provide type, profile, and hardness as required to maintain watertight seal.

1. Dense compression type: Molded or extruded material, black.
    a. EPDM gasket complying with ASTM C864.
    b. Silicone complying with ASTM C1115.
    c. Thermoplastic polyolefin rubber complying with ASTM C1115.
2. Soft compression type: Molded or extruded, closed-cell, integral-skinned, black gasket complying with ASTM C509, Type II.
    a. EPDM.
    b. Silicone.
    c. Thermoplastic polyolefin rubber.

H. Sealants: Liquid applied, chemically curing type complying with ASTM C920, compatible with materials and conditions, and capable of anticipated joint movement without watertight seal failure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Damaged glass: Do not install glass with edge damage or other imperfections. Remove from site and replace.

B. Install setting blocks and spacers as recommended by referenced glazing standards and glass manufacturer's recommendations. Set blocks in sealant.

C. Provide edge blocking as required to prevent sideway movement of glass in glazing channel.

D. Ensure glazing channels and stops provide required bite on glass, minimum edge and face clearances, and adequate sealant thickness.

E. Tape Glazing:

1. Cut glazing tape to length and set continuously against permanent stops and projecting slightly above sightline.
2. Tape joints: Butt joints. Do not overlap tape. Seal joints with compatible sealant.
3. Rest glass on setting blocks and push against tape for full contact at perimeter of lite.
4. Remove tape release paper immediately prior to placing glass

F. Gasket Glazing:

1. Fabricate two-piece compression gaskets to exactly fit openings.
2. Install soft compression gasket against permanent stops. Miter cut and bond together corners.
3. Rest glass on setting blocks. Insert dense compression gasket to press glass against soft gasket and lock in place against removable stop.
4. Apply sealant to gasket joints.
5. Install gaskets to protrude slightly beyond glazing stops.

G. Wet Sealant Glazing:

1. Install spacers and sealant backing between glass and stops. Position to control depth and width of sealant.
2. Apply sealant to glazing channels without voids. Ensure complete bond of sealant to glass and channel surfaces.
3. Tool exposed sealant surfaces to provide wash away from glass.

3.02 CLEANING

A. Clean glass immediately following installation. Remove sealants and other glazing materials from adjacent finished surfaces.

B. Remove labels and prior to final inspection; clean glass.

END OF SECTION

SECTION 09 10 00
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 01 33 00 - Submittal Procedures

B. Section 09 96 00 - Industrial Paints and Coatings

C. Division 23 - Heating, Ventilating, and Air-Conditioning

D. Division 26 - Electrical

E. Division 40 - Process Integration

F. Division 41 - Material Processing and Handling Equipment

G. Division 42 - Process Heating, Cooling, and Drying Equipment

H. Division 43 - Process Gas/Liquid Handling, Purification, & Storage Equipment

I. Division 44 - Pollution Control Equipment

1.03 SUBMITTALS

A. In accordance with Section 01 33 00 - Submittal Procedures, 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 the following:

1. Color coding in accordance with the Piping Identification Schedule;

2. A painted label; and

3. A directional flow arrow.

C. 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.

D. Color Bands and Arrows:

1. Pipe color bands shall be painted on the pipe. Paper or plastic banding of pipe shall not be acceptable.

E. Arrows shall be of the same color as the lettering and shall point away from the lettered labels in the direction of the flow.

1. Color band size shall be as follows:

Pipe Size (Outside Diameter)	Color Band Width
< 1”	1”
1” – 12”	1 pipe diameter
> 12”	12”

F. 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. 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 Engineer.

B. Piping shall also be identified at a point approximately within 2 feet of turns, ells, valves, and on the upstream side of 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
Domestic Water	
Potable Water (RP Device)	Light Blue
Fresh Water (Air Gap)	Light Blue
Industrial and/or Cooling Water	
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
Chemical Supply Lines (Extremely Dangerous)	
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
Chemical Supply Lines	
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
Sludge/Ash Transport and Process Lines	
Blended Sludge	Dark Brown
Bottom Sludge	Dark Brown
Centrate (from digested sludge dewatering)	Dark Brown/Dark Blue
Centrate (H2S Scrubbing)	White/Yellow
Circulated Sludge	Dark Brown
Digested Sludge	Dark Brown
Sulfur Slurry (H2S Scrubber)	Dark Brown
Sludge/Ash Transport and Process Lines	
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
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
Pneumatic Transport Lines	
Sludge Derived Fuel	Light Green/Orange
Hot Ash	Light Green/Yellow
Sand Transport	Light Green
Air and Vacuum Supply Lines	
Oxygen (gaseous)	Purple/Black
Oxygen (liquid)	Purple/Black
Combustion Air	Green
Compressed Air (non-instrument)	Green/Red
Air and Vacuum Supply Lines	
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
Boiler Waters	
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 96 00
PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

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 WORK SPECIFIED ELSEWHERE

A. Section 04 20 00 - Unit Masonry

B. Section 05 12 00 - Structural Steel Framing

C. Section 05 50 00 - Metal Fabrications

D. Section 08 11 50 - Custom Steel Doors

E. Section 08 12 13 - Custom Steel Frames

F. Section 08 33 23 - Overhead Doors

1.03 REFERENCE STANDARDS

A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

B. AWWA (American Water Works Association) - D102-17 - Painting Steel Water Storage Tanks.

C. International Concrete Repair Institute (ICRI) Guideline No. 310.2-R2013 - 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.

F. NAPF (National Association of Pipe Fabricators) Section 500 Surface Preparation Standards.

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 33 00 - Submittal Procedures.

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 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.

E. A letter certifying the installer as a Manufacturer’s Approved Installer shall accompany the submittal package.

F. Daily Coating Inspection Reports (blank version included at the end of this Section) are to be submitted weekly to Engineer. One report is to be completed for each day of painting activity performed on the job site. Reports must be fully filled out. Payment may be withheld if reports are not submitted in a timely fashion or are not fully completed.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section and one of the companies listed.

B. Applicator: Company specializing in performing the work of this section with minimum ten years, approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 - Product Requirements.

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 F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

F. 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.

1.08 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:

D. Minimum application temperatures shall be as required by the coating manufacturer's instructions.

E. If there are no explicit printed recommendations by the manufacturer, minimum temperature of the air and surface to be painted shall be 50° Fahrenheit.

F. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface during coating operations in the area being painted.

G. Provide adequate ventilation at all enclosed spaces. Additional ventilation may be required to prevent fumes from affecting adjacent Owner-occupied spaces.

1.09 SURFACES NOT REQUIRING PAINTING

A. Aluminum (except for backcoating as specified in Section 3.2F).

B. Stainless Steel.

C. Copper.

D. FRP.

E. PVC, CPVC, HDPE and Fiberglass Pipe and Ductwork (including hangers).

F. PVC Coated Electrical Conduit.

G. Inside of pipe spaces, duct shafts, and similar areas not exposed to view.

H. Exterior galvanized grating or checkered plate need not be painted, except to meet MIOSHA requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers - Paint and Special Coatings:

1. Tnemec Company
2. Carboline Company
3. Sherwin-Williams Company
4. Substitutions: No substitutions are allowed.

B. All products used on this project shall be from the same manufacturer unless written approval is received from the 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 the 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 F2170.

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. Mildewed 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 an Owner approved epoxy/sealer (Tnemec Series N69 or Carboline Rustbond penetrating sealer; or Sherwin-Williams Macropoxy 646) 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. All 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 surfaces.

H. Fiberglass, PVC, CPVC or HDPE 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 the 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-16 – Brush Off Blast Cleaning of Coated or Uncoated Galvanized Steel, Stainless Steel and Non-Ferrous Metals.

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. Once prepared, galvanized surfaces are to be treated with Great Lakes Laboratories “Clean ‘n Etch” in accordance with Manufacturer’s requirements.

4. Cleaned surfaces shall not remain overnight without a prime coat.

J. PAINTING SYSTEM NO. 3A - New and Existing Interior Masonry units

1. Surface Preparation - SSPC-SP 13/NACE 6. Remove loose and flaking paint, feather edges. Abrade soundly adhered coating to remove gloss.

	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 Epoxoline	4.0	Polyamide Epoxy
Finish	1	Tnemec 1075 Endura Shield	4.0	Aliphatic/ Acrylic Polyurethane
Undercoat	1	Carboline Sanitile 500 Block Filler	60-100 s.f. gal.	Water Based Epoxy Filler
Primer	1	Carboline Carboguard 890	4.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline Carboguard 134 HG	4.0	Aliphatic Polyurethane
Undercoat	1	Sherwin-Williams Cement-Plex 875	60-100 s.f. gal.	Cementitious Waterborne Block filler
Primer	1	Sherwin-Williams Macropoxy 646	4.0	Polyamide Epoxy
Finish	1	Sherwin-Williams Acrolon 218	4.0	

Contractor shall choose one of Undercoat-Primer-Finish systems listed above. *Undercoat not required at existing or previously painted masonry.*

Total Thickness of System – 8.0 Dry Mils Minimum over filled surface.

K. PAINTING SYSTEM No. 3B - Interior exposed precast and poured in place concrete

1. Surface Preparation - Same as above

Primer and Finish - Same as above, but without Undercoat

Total Thickness of System – 8.0 Dry Mils Min.

L. Concrete and Unit Masonry Surfaces:

1. Prepare all cementitious substrates referencing SSPC-SP13.
2. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.
3. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry.
4. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
5. Allow to dry.
6. Application of block filler will be by roller or brush.
7. Spraying will not be allowed.

M. Ductile Iron:

1. Remove grease, dirt, and other visible contaminants by washing with solvent (NAPF 500-03-01).
2. Where mill scale, weld spatter, and rust are evident, remove by power tool wire brushing (NAPF 500-03-03) or where required, abrasive blast cleaning (NAPF 500-03-04 and 500-03-05).
3. Spot prime paint after repairs.
4. Actual surface preparation procedure shall be based on approved coating manufacturer's published recommendations.

N. Shop Primed Steel Surfaces:

1. Prepare surfaces per SSPC 2/3 hand or power tool cleaning. 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.

O. 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. Apply each coat to uniform finish.

C. Do not apply signs or pipe/equipment labels, etc. prior to installing coatings.

D. 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 Shercryl HPA which complies with the Color Code prescribed herein.

E. Material labels and accompanying direction of flow arrows shall be applied to all distribution mains on maximum spacing of 50'.

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. All 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 an Owner's approved background color in full or abbreviated, to meet the Owner's requirements and print the width of the label.

F. 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.

G. 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 the 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.

H. Hazardous areas, moving machinery, handrails, and all other similar areas shall be finished to agree with the Owner's Standard Safety Code and all MIOSHA requirements, as approved by the Owner.

I. Refer to Section 26 05 53 - Electrical Identification.
1. Refer to the end of this Section for color coding and identification banding of equipment, duct work, and piping.

J. Paint shop primed equipment.

K. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

L. Prime and paint exposed pipes, conduit, boxes, ducts, hangers, brackets, collars and supports.

M. Paint dampers exposed behind louvers, grilles, to match face panels.

N. Paint exposed conduit and electrical equipment occurring in painted areas.

O. Paint both sides and edges of plywood backboards before installing equipment.

P. 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.

Q. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 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. All reports shall be available to the Owner and the Owner’s representative upon request at the site.
5. Copies of these daily reports shall be submitted within (7) seven days from date of work for all painting and coating work performed on this project.
6. Failure to submit reports in a timely fashion 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 45 00 - Quality Control.

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 the Owner.

1. Repair areas shall be to a suitable area boundary as determined by the 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.

3.05 CLEANING

A. Clean work under provisions of Section 01 77 00 - Closeout Procedures.

B. Collect waste material, 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.

3.06 SCHEDULE - ALL INTERIOR AND EXTERIOR SURFACES

Paint System	Surfaces
1	Exterior/Interior Ferrous Metals, Piping and Equipment
3A	Interior Masonry Units
3B	Interior exposed precast and poured in place concrete, including interior concrete wall surfaces below grade (not specified elsewhere).
6	Submerged Below Grade Buried Ferrous Mechanical Equipment Components and Piping

A. All 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.

B. Aluminum Surfaces shall be backcoated with an Owner approved epoxy/sealer. Refer to Section 3.2.E of this Painting Specification.

3.07 PAINTING - SYSTEMS

(Contractor shall refer to Products Section herein with regard to acceptable material manufacturers.)

A. PAINTING SYSTEM NO. 1 –Exterior/Interior Ferrous Metals, Piping and Equipment

1. Surface Preparation, Ductile Iron Pipe – NAPF 500-03-04

2. Surface Preparation, Ductile Iron Valves and Fittings – NAPF 500-03-05

3. Surface Preparation, Galvanized Steel – SSPC-SP 16 and Clean ‘n Etch

4. Surface Preparation, All Other Surfaces – SSPC-SP 6

	Min. No. of Coats per Coating Layer	Product Name	Min. Total Thickness of Coating Layer Dry	Type
Primer	1	Tnemec Series N69	4.0	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 Carboguard 890	4.0	Cycloaliphatic Amine Epoxy
Intermediate	1	Carboline Carboguard 890	4.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline Carbothane 134 HG	3.0	Aliphatic Polyurethane
Primer	1	Sherwin-Williams Macropoxy 646	4.0	Polyamide Epoxy
Intermediate	1	Sherwin-Williams Macropoxy 646	4.0	Polyamide Epoxy
Finish	1	Sherwin-Williams Acrolon 218	3.0	Aliphatic Polyurethane

CONTRACTOR shall choose one of Primer-Intermediate-Finish systems listed above.

Total Thickness of System – 11.0 Dry Mils Min.

CONTRACTOR shall note curing times required between coats, per actual product used.

B. PAINTING SYSTEM NO. 3A – New and Existing Interior Masonry units

1. Surface Preparation - SSPC-SP 13/NACE 6. Remove loose and flaking paint, feather edges. Abrade soundly adhered coating to remove gloss.

	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 Epoxoline	4.0	Polyamide Epoxy
Finish	1	Tnemec 1075 Endura Shield	4.0	Aliphatic/ Acrylic Polyurethane
Undercoat	1	Carboline Sanitile 500 Block Filler	60-100s.f. gal.	Water Based Epoxy Filler
Primer	1	Carboline Carboguard 890	4.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline Carboguard	4.0	Aliphatic

		134 HG		Polyurethane
Undercoat	1	Sherwin-Williams Cement-Plex 875	60-100 s.f. gal.	Cementitious Waterborne Block filler
Primer	1	Sherwin-Williams Macropoxy 646	4.0	Polyamide Epoxy
Finish	1	Sherwin-WilliamsAcrolon 218	4.0	Aliphatic Polyurethane

CONTRACTOR shall choose one of Undercoat-Primer-Finish systems listed above. Undercoat not required at existing or previously painted masonry. Total Thickness of System – 8.0 Dry Mils Minimum over filled surface.

C. PAINTING SYSTEM No. 3B - Interior exposed precast and poured in place concrete

1. Surface Preparation - Same as above
2. Primer and Finish - Same as above, but without Undercoat

   Total Thickness of System – 8.0 Dry Mils Min.

D. PAINTING SYSTEM NO. 6A - Submerged & Below Grade Buried Ferrous Mechanical Equipment Components and Piping (non-potable) (Non Coal Tar)

1. Surface preparation, Submerged Ferrous Metal - SSPC-SP10
2. Surface preparation, Below Grade Ferrous Metal – SSPC-SP16 and Clean ‘n Etch
3. Surface preparation, Ductile Iron Pipe – NAPF 500-03-04
4. Surface Preparation, Ductile Iron Valves and Fittings – NAPF 500-03-05

	Min. No. of Coats per Coating Layer	**Product Name**	**Min. Total Thickness of Coating Layer Dry**	**Type**
Finish	1	Tnemec G435 Perma-Glaze	40.0	Modified Polyamide Epoxy
Finish	1	Carboline Plasite 4550 S	40.0	Reinforced Epoxy Novolac
		or		
Finish	2	Carboline Phenoline Tank Shield	20.0	Phenolic Epoxy Novolac
Finish	1	Sherwin-Williams Dura-Plate 6000	40.0	Reinforced Epoxy

CONTRACTOR shall choose one of Finish systems listed above.

Total Thickness of System – 40.0 Dry Mils Min.

3.08 SCHEDULE -EQUIPMENT COLORS

A. Blowers *
B. Compressors *
C. Couplings Yellow
D. Cranes (Hoists) Yellow
E. Blocks Yellow and Capacity in Black

F.	Fans	Orange
G.	Flow Meters	*
H.	Gear Reducers	Yellow
I.	Guards	Orange
J.	Motors	Orange
K.	Pumps	*
L.	Screens	*
M.	Switch Enclosure	Orange
N.	Tanks	*
O.	Valves	*
P.	Valve Operators	Yellow
Q.	Handrail/Guardrail	Orange **
R.	Handrail/Guardrail-Removable	Yellow & Black **
S.	Fire Protection Equipment	Red
T.	Emergency Stop Bars, Buttons, Etc.	Red
U.	First Aid Kits and Enclosures-	
	1. containing First Aid Equipment	Green
V.	Safety Showers, Face Washes, etc.	
	1. (Area Around)	Green
W.	Transformers	Orange
X.	Switchgear	Grey or Buff
Y.	Misc. Metal	Black (unless otherwise noted)

AA. * Color will depend on service. The color will be obtained from the “PIPE COLOR CODE" for the service. (No stripes used on equipment.)

BB ** Brass, aluminum or stainless steel need NOT be painted.

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

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

3.09 SCHEDULE -PIPING COLORS

SERVICE	COLOR	STRIPE
A. Potable Water – Cold	Green	
B. Potable Water – Hot	Green	Aluminum (1)
C. Emergency Shower Water	Green	Yellow (1)
D. Flushing Water	Gray	Blue (1)
E. Decant Water	Gray	White (1)
F. Industrial Water	Blue	
G. Ground Water	Blue	Green (1)
H. Instrument Air	Purple	Blue (1)
I. Natural Gas	Yellow	
J. Vacuum	Purple	Aluminum (1)
K. Roof Conductors	Match Background	
L. Floor Drains	Match Background	
M. Sump Pump Discharge	Gray	Black (1)
N. Sanitary Drains & Vents	Black	
O. Raw Sewage or Waste Water	Gray	
P. Sample Lines	Match System Being Sampled	
Q. Electrical Conduit	Match Background	
R. Stainless Steel	6" band with 3/4" stripes at 1"	
S. Copper	6" band with 3/4" stripes at 1"	
T. Plastic	6" band with 3/4" stripes at 1"	
U. Low Pressure Air	per Owner	
V. Compressed Air	per Owner	
W. Grit	per Owner	
X. Sludge	per Owner	

Paint Inspection:

Daily Coating Inspection Report

Project/Client:	Date: / / M T W Th F S Su	Pg. Of
Location:	Project #:	COPY To: ☐ QC Mgr ☐ Owner
Description:	Inspector:	☐ Contr ☐ _____
Requirements:		Attachments: ☐ DFT Sheet ☐ NCR/CAR ☐ _____
Contractor:	Spec #	Revision #

Description of Areas & Work Performed

Hold Point Inspections Performed

- ☐ 1 Pre Surface Pep/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

- ☐ New ☐ Maint ☐ Primer/Paint ☐ Age/Dry/Cure_____
- ☐ Steel ☐ Galvanize ☐ Concrete ☐ Other_____
- ☐ Hazard _____ ☐ Sample Report # _____
- ☐ Degree of contamination: _____
- Test: ☐ Cl_____ µg/cm² / 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 _____

Surface Preparation

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

Surface Cleanliness & Profile Measurement

- ☐ 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

Dry Film Thickness

Gage Type / Model	Gage Serial #	Gage Calib. Verified	Spec Avg. DFT	Total Avg DFT	DFT Last Coat	DFT This Coat

Ambient Conditions

Time (Indicate AM or PM)	:	:	:	:
Dry Bulb Temp° (C/F)	°	°	°	°
Wet Bulb Temp° (C/F)	°	°	°	°
% Relative Humidity	%	%	%	%
Surface Temp° (C/F) Min/Max	/ °	/ °	/ °	/ °
Dew Point Temp° (C/F)	°	°	°	°
Wind Direction/Speed				
Weather Conditions:				

Application

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:	°F
Kit Sz/Cond.:		Sweat-in Time:	Min/Hrs
Shelf Life:		Pot Life:	Min/Hrs
Batch #'s		Reducer #:	
(A)		Qty Added:	Pt/Qt/Gal
(B)		% by Vol:	%
(C)		Specified WFT Avg:	Mils
Reducer:		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

Inspector's Signature Date

SSPC the society for protective coatings Created03/03 by

END OF SECTION

SECTION 22 10 00
PLUMBING MATERIALS AND METHODS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Section includes piping materials and installation methods including, but not limited to pipe, fitting and joining materials, piping specialties, and basic piping installation instructions.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

1.03 REFERENCE STANDARDS

A. ANSI B9.1, Standard Safety Code for Mechanical Refrigeration.

B. ANSI B31.1.0 - Standard Code for Pressure Piping, Power Piping, and The American Welding Society, Welding Handbook.

1.04 SUBMITTALS

A. Submit product data for the following:

1. Escutcheons.
2. Dielectric unions and fittings.
3. Mechanical sleeve seals.

B. Quality Control Submittals: Submit welders' certificates specified in Quality Assurance Article below.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide factory applied plastic end-caps on each length of pipe and tube except for concrete, corrugated metal, hub and spigot, and clay pipe.

B. Maintain end-caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

D. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

E. Store pipe in a manner to prevent sagging and bending.

1.06 QUALITY ASSURANCE

A. Welder's Qualifications: Welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI B31.1.0 and ANSI B9.1.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Pipe Escutcheons:
    a. Chicago Specialty Mfg. Co.
    b. Grinnell.

c. Sanitary-Dash Mfg. Co.

2. Dielectric Waterway Fittings:
   a. Epco Sales, Inc.
   b. Victaulic Company of America.
3. Dielectric Unions:
   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.
4. Mechanical Sleeve Seals:
   a. Thunderline Corp.
5. High-Impact Thermoplastic Wall Sleeve:
   a. Thunderline.
   b. Silicone Rubber Adhesive:
   c. General Electric.
6. High-Density Polyethylene Pipe (64.2):
   a. Driscopipe 8000.
   b. Nipak.
   c. Dupont.
7. High-Density Polyethylene Pipe (64.7):
   a. Driscopipe 8600.
   b. Nipak.
   c. Dupont.

2.02 MATERIALS

A. Refer to the individual piping system specifications in Sections 22 1113 for specifications on piping materials required from those listed below:

1. Steel Pipe (61.1):
   a. Normal Service Pressure: Up to 150 psig
   b. Temperature: Up to 366 degrees Fahrenheit

Type	Size	Specification
Pipe	1/4-inch thru 4-inch	Carbon steel pipe, Schedule 40, ASTM A 120 seamless or electric welded. Note: Standard weight and Schedule 40 are the same in all sizes through 10 inches; in larger sizes, the wall thickness differs.
Types of Joints	1/4-inch thru 2-inches	Screwed
	2-1/2-inch and larger	Welded
Fittings	1/4-inch thru 2-inches	Black malleable iron, 150-pound class, screwed. ANSI standard B16.3
Nipples	1/4-inch thru 2-inches	Carbon steel, extra strong, ASTM A 120 or A 53

Unions	1/4-inch thru 2-inches	Malleable iron, 250-pound class (500 WOG), railroad type with brass seats
Thread Sealant		Pipe dope. John Crane Insoluble Plastic Lead seal No. 2 or approved equal. Exception: For temperatures in excess of 250 degree Fahrenheit, use Teflon ribbon, 1/2-inch wide.

2. Cast Iron (62.2):
   a. Temperature: Up to 180 degrees Fahrenheit

Type	Size	Specifications
Pipe	2-inches thru 15-inches	Cast iron soil pipe, plain end, service weight (SV), bituminous coating inside and outside. Cast Iron Soil Pipe Institute Std. 301
Type of Joints	2-inches thru 15-inches	No-hub coupling.
Fittings	2-inches thru 15-inches	Cast iron soil pipe, no-hub type, service weight (SV), bituminous coating inside and outside. Cast Iron Soil Pipe Institute Std. 301.

3. Copper Tubing (63.1):
   a. Normal Service Pressure: Up to 150 psig
   b. Temperature: Up to 250 degrees Fahrenheit
   c. Use solder fittings at all joints between terminal points.
   d. Bends may be used for 1/4-inch and 3/8-inch tubing.
      1) Bends shall be made with a bending tool to the following minimum radii:
         (a) 1/4-inch: 9/16-inch minimum radius
         (b) 3/8-inch: 15/16-inch minimum radius

Type	Size	Specification
Pipe	All sizes	Copper tubing, type L, hard-drawn above ground. Type K (soft) for below grade
Types of Joints	1/4-inch thru 1/2-inch	Soldered or compression type as required
	5/8-inch and larger	Soldered (Exposed), Flared (Buried)
Compression	1/4-inch thru 1/2-inch	Brass compression type fittings
Fittings (Exposed)	All sizes	Gyrolok, Swagelok, Parker CPI
Unions	1/4-inch thru 2-inches	Wrought copper or cast bronze; solder joint union
Flanges	All sizes	Copper, solder-joint flange. 150-pound ASME drilling. Raised or flat face to match equipment
Gaskets		1/16-inch Teflon; ring type for raised-face, or full-face for flat face flange
Solder		Tin/Antimony (or lead-free to meet Code requirements)
Thread Sealant		Teflon tape

4. High Density Polyethylene Pipe (64.2) for Gas Distribution:
   a. Normal Service Pressure: 80 psig

b. Temperature: Up to 140 degrees Fahrenheit

Type	Size	Specifications
Pipe	3/4-inch and larger	High-density polyethylene, SDR-11, ASTM D2513, PE 3408
Type of Joints	3/4-inch and larger	Fusion welded, ASTM D2513 or socket
Fittings	3/4-inch and larger	High-density polyethylene, SDR-11, socket fusion type, with diameters compatible with pipe for fusion joining
Gaskets	3/4-inch and larger	1/16-inch solid neoprene, full-face type
Flanges	3/4-inch and larger	PVC, 150-pound, flat-face, Sch 80, socket type

5. PVC DWV Pipe (64.6):

a. Normal Service Pressure: 5 psig (maximum)

b. Temperature: Up to 150 degrees Fahrenheit

Type	Size	Specifications
Pipe	1-inch thru 8-inches	PVC, Sch 40, ASTM D2665
Type of Joints	1-inch thru 8-inches	Solvent welded
Fittings	1-inch thru 8-inches	PVC, Sch 40, socket type, ASTM D2949

6. High-Density Polyethylene Pipe (64.7) for Sump Discharge:

a. Normal Service Pressure: 80 psig (maximum)

b. Temperature: Up to 140 degrees Fahrenheit

Type	Size	Specifications
Pipe	3/4-inch and larger	High-density polyethylene, SDR-11, ASTM D3350, PE 3408
Type of Joints	3/4-inch and larger	Fusion welded, ASTM D 3261 or socket. ASTM D2683
Fittings	3/4-inch and larger	High-density polyethylene, SDR-11, socket fusion type, with diameters compatible with pipe for fusion joining
Gasket	3/4-inch and larger	1/16-inch solid hypalon, full-face type
Flanges	3/4-inch and larger	PVC, 150-pound, flat-face, Sch 80, socket type

2.03 JOINTING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed, and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome plated, stamped steel, hinged, split-ring escutcheon with setscrew. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable iron, Class 150 for low-pressure service and Class 250 for high-pressure service; hexagonal stock with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion. Insulated and gasketed, galvanized, malleable iron unions as manufactured by Crane No. 1259, ITT-Grinnell, Figure 470, or equal.

D. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Sleeves: Unless otherwise shown on Drawings, at all points where pipes must pass through walls, floors or roofs of structures, Contractor shall furnish and install suitable sleeves or wall castings.

1. In general, the wall sleeve or casting shall be of the same material as the pipe, or standard weight steel pipe thimbles of at least 1 size larger than the pipe itself shall be installed. Iron pipe wall castings, wall pipe, transition sleeves and solid sleeves shall meet the requirements or AWWA Specifications C100 and shall be of the lightest class conforming to the pressure rating of the pipelines which they connect, but in no case shall be lighter than Class B. Sleeves shall be shop coated with universal primer 2 mils minimum thickness.

2. A high-impact thermoplastic wall sleeve as manufactured by Thunderline may be used for low and standard temperature service.

F. Sleeve Seals:

1. Unless otherwise shown or permitted, the space between the pipe and the sleeve shall be caulked at the inside and outside wall faces on walls exposed to earth or water/sewage, at one face of the other walls, and at the top surface of floors and slabs. The space shall be caulked with lead and oakum as specified under Bell and Spigot Lead with an RTV-silicone rubber adhesive as manufactured by General Electric or sealed with a rubber link seal. Rubber link seal shall be identical rubber links interconnected with bolts and elongated nuts and washers.

2. Sealing element shall be made of synthetic rubber material especially compounded to resist aging, ozone, sunlight, and chemical action.

3. Bolts and metal parts shall be made of galvanized or cadmium-plated steel to resist corrosion. Rubber link seal joints shall be submitted to Engineer for approval.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATION

A. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as

practical, install piping as indicated. Refer to individual system specifications for requirements for submittals.

B. Piping shall be exposed unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on Drawings.

E. Install piping far enough from slabs, beams, joists, columns, walls, and other permanent elements of the building to permit access for painting. Provide space to permit insulation applications, with 3-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.

3.03 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2-inch and smaller connections, and elsewhere as indicated.

D. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).

E. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.04 JOINTS

A. Steel Pipe Joints:

1. Pipe 2-inch and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1.

    a. Cut threads full and clean using sharp dies.

    b. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

B. Pipe Larger than 2-inches:

1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0, Standard Code for Pressure Piping, Power Piping, and ANSI B9.1, Standard Safety Code for Mechanical Refrigeration.

2. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4-inch and smaller.

3. Joints for other piping materials are specified within the respective piping system sections.

3.05 TESTING

A. Refer to individual piping system specification Sections for more information regarding testing.

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Base- or frame-mount, close-coupled, end-suction pumps.

B. Pressure booster systems.

1.02 RELATED REQUIREMENTS

A. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.

B. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 26 05 83 - Wiring Connections.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.

B. ICC (IPC) - International Plumbing Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.

F. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:

1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.

2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.

C. Shop Drawings: Include dimensions and performance data.

D. Test Reports: Plumbing fixture operational tests.

E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

F. Executed warranty.

G. Specimen warranty.

H. Project Record Documents: Record actual locations of components.

I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements for additional provisions.

2. Extra Pump Seals: One of each type and size.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing type of products specified in this section, with minimum three years of documented experience.

B. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.

C. Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 1-year manufacturer warranty for pumps except circulator type. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 BASE- OR FRAME-MOUNT, CLOSE-COUPLED, END-SUCTION PUMPS

A. Description: Close coupled, single-stage pump, maximum discharge pressure of 175 psi.

B. Casing: Split type, bronze with renewable bronze casing wearing rings, seal flush connection.

C. Impeller: Stainless steel, balanced, fully enclosed, keyed to shaft.

D. Drive: Flexible coupling with coupling guard.

E. Bearings: Oil-lubricated roller or ball bearings.

F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

G. Baseplate: Cast iron or fabricated steel with integral drain rim.

H. Base Vibration Isolation: See Section 22 05 48.

I. Pipe-End Connections: Class 150 flange.

J. Electrical:

1. 3 hp.
2. 480 VAC, three phase, 60 Hz.
3. Motor: 1,750 rpm, total-enclosed, fan-cooled (TEFC); see Section 22 05 13.
4. Motor Controller: VFD with local disconnect.
5. Motor Protection: Include overvoltage, overcurrent, and motor overload.
6. Pilot Indicators: Provide fault or trip, hand-off-auto, overvoltage, overcurrent, motor overload, run status, and run-time counter.
7. Wiring Connections: See Section 26 05 83.
8. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

K. Integral Controls:

1. Variable Frequency Drive (VFD): Factory-fitted and tested with dedicated terminal box for power, instrumentation, and related control wiring.

2.02 PRESSURE BOOSTER SYSTEMS

A. Description: Self-contained factory assembled pump skid with isolation valves, strainers, gauges, pipe and Class 300 fittings, system drain valve(s), component identification, signage, electrical raceway, equipment tags, instruments, and controls fitted on fabricated structural steel frame skid base; tested, adjusted, and shipped as integral unit.

B. Maximum Discharge Pressure: 250 psi.

C. Skid Capacity Load Distribution: Triplex; 2 leads at 35 percent and lag at 30 percent.

D. Skid Vibration Isolation: See Section 22 05 48.

E. Pump Assembly: Turbine type, cast iron casing, stainless steel impeller and bearings.

F. Mechanical Seal: Carbon rotating against a stationary ceramic seat.

G. Pump Motor: Inverter duty, VFD-controlled 1,750 rpm, open drip-proof (ODP) type.

H. Pipe-End Connections: Class 300 flange for sizes 4 inches and larger otherwise threaded.

I. Pipe and Fittings Material: Galvanized steel, Schedule 40, factory finished.

J. Low-Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.

K. Isolation and Control Valves:

1. Pump outlet combined pressure-reducing check valve assembly for near-uniform pressure.

2. Butterfly valves at pump suction and discharge sides for pipe sizes above 4 inches, ball valves are acceptable for smaller pipe sizes.

3. Actuators: If required, provide electronic type for modulation control, line voltage type for pipe or equipment isolation, or pneumatic type for high torque or nonwater applications.

4. Manual Operators: Lock-out tag-out (LOTO) type for manual and actuator operated.

L. Component Identification: ASME A13.1 for pipes and equipment and NFPA 70 for electrical.

M. Service Temperature Range: Minus 30 to 250 degrees F.

N. Instrumentation and Controls:

1. Provide skid-mount instruments and control devices where required with proper raceway, cables, and wires into control panel with panel-door interlocked main disconnect switch.

2. Instrument, Device, and Control-Enclosure Rating: NEMA 250, Type 4.

3. Controller Type: Panel-coordinated programmable logic controller (PLC) with fuse protected controls transformer and power supplies.

4. Operating Interface per Pump:

a. Components: HOA selector switch, suction, and discharge side pressure gauges, resettable run-time meter per pump.

b. Indicators: Provide illuminated indicators of incandescent or LED-based pilot light type per pump; green for run status, yellow for safety, red for alarm, and black or blue for out-of-service.

c. Graphic Panel: Color touchscreen display, use graphics instead of listed components, and indicators except for pump override switches with respective indicators.

5. Minimum Control Components:
    a. Magnetic starter or variable frequency drive for motor control with overcurrent protection, overvoltage protection and current sensor per pump.
    b. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.
    c. Pump Alternating: Have pumps set for lead/lag operation. Alternate pumps based on run time or manually selected order. Use alternating relay for noncontroller system.
    d. Low- and High-Limit pressure cutout and temperature cut out switches.
    e. Pressure Control Signal: Include pressure-indicating transmitter for remote mounting.
    f. Time Delay Function or Relay: Prevent lag pump short cycling on fluctuating demands.
    g. Time Clock Function or Relay for Automatic Day-Night Changeover:
        1) Day Cycle: System to operate continuously with pressure to fixtures maintained by pressure-reducing valves.
        2) Night Cycle: Pump to operate intermittently on pressure switch located near pressure tank operating pump for predetermined adjustable time period.
6. Alarm and Warning Indicator: Panel-mounted audio-visual station with stack-fitted red and amber colored lamps and 100 dB, 100 feet strobe or horn.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products with related fittings, and accessories according to manufacturer instructions.

B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).

C. Electrical-Driven Pump Work:
1. Provide electric-motor-driven equipment specified complete with local disconnect switch and control panel with starter, controls, safety devices, and related wiring.
2. Provide automatic control and protective devices field-wired to interface-related devices required for specified operation.

D. Ensure that small pressure gauges are installed on both upstream and downstream ends.

E. Sump Pumps: Ensure shaft length of sump pump located minimum of 24 inches below lowest invert into sump pit with minimum of 6 inches clearance from bottom of sump pit.

F. Base-Mount Pumps and Pressure Booster Pump Skids:
1. Provide air cock and drain connection. Align and verify alignment of base prior to start-up.
2. Provide line-sized isolating valve with strainer or triple-duty valve on suction end and line-sized, soft-seated check valve with balancing valve on discharge end.

G. Factory-Provided Pump Controls: Factory provided, tested for use.

H. ECM, VSD, or VFD Controlled Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate in automatic to maintain downstream pressure setpoint.

I. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

A. Thoroughly clean plumbing fixtures and equipment.

B. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.04 PROTECTION

A. Protect installed products from damage due from subsequent construction operations.

B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION

SECTION 22 13 33.13
SUBMERSIBLE WASTEWATER PUMPS WITH INTEGRATED PUMP CONTROL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work in this section shall include furnishing and placing into operation 2 stationary submerged mounted sewage pump system(s) complete with submersible motor, submersible cable, discharge connection, lifting chains and guide rails, control panel, and level instruments as specified herein and as indicated on the drawings. The complete pump system shall be submersible up to 65 feet.

B. Work shall include:

1. Communications gateway for each Pumping System (CPS)
2. Pump station controller capable of controlling all CPS
3. Remote monitoring equipment compatible with the manufacturer's remote monitoring system
4. Surge protection
5. Commissioning of the control panel
6. Site Acceptance Testing (SAT)

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 60 00 - Product Requirements

C. Section 01 77 00 - Closeout Procedures

D. Section 40 63 00 - Instrumentation and Controls

1.03 DESCRIPTION OF SYSTEM

A. The pump station shall be equipped with 2 submersible sewage pump(s) with an integrated pump control system.

B. It shall be possible to lift and lower the pump on parallel guide bars and connect it to wet well mounted discharge connection. There shall be no need for personal to enter the wet well when removing or reinstalling the pumps.

C. Sealing of the pump unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the pump discharge interface with an O-ring, diaphragm or profile gasket is not acceptable.

D. The impeller shall be a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes. It shall be wear resistant against sand and grit which is expected to enter the pump station with the sewage or the storm water.

E. Each pump shall be capable to lift 660 gpm at a total dynamic head of 43 feet.

F. The NPSHre shall be below 15 feet.

G. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and/or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall, either travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost or reimburse

the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

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. ASTM A48/A48M - Standard Specification for Gray Iron Castings
2. ASTM A743/A743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
3. ANSI B16.1 - Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.
4. HI 14.6 - Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests
5. HI 11.6 - Submersible Pump Tests
6. ISA
7. NFPA 70 - National Electric Code, 2017
8. NFPA 820 - Standard for Fire Protection in Wastewater
9. ISA-5.1 - Instrumentation Symbols and Identification
10. ISA-5.4 - Instrument Loop Diagrams
11. UL 508A - Industrial Control Panels
12. UL 698A - UL Standard for Safety Industrial Control Panels Relating to Hazardous (Classified) Locations

1.05 SUBMITTALS

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of the following items. Lack of the requested submittal data is cause for rejection.

1. Pump Performance Curves.
2. Outline and Dimension Drawing(s).
3. Station Drawing for Accessories.
4. Electrical Motor Data.
5. Wiring Diagrams.
6. Enclosure Mounting Details.
7. Typical Installation Guides.
8. Technical Manuals.
9. Parts List.
10. Printed Warranty.
11. Management system certificate ISO 9001.
12. Manufacturer's Equipment Storage Recommendations.
13. Manufacturer's Standard Recommended Start-Up Report Form.

1.06 QUALITY ASSURANCE

A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.

B. The pump system manufacturer shall design and build the control panel for the integrated pump control system.

C. After installation, start-up shall be performed by the Contractor under the supervision of the manufacture's authorized representative. A minimum of 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. Contractor shall be responsible for coordinating the required field services with the manufacturer.

D. Contractor shall supply the pump manufacturer's warranty against defects in workmanship and material for a period of one (1) year from the date of Substantial Completion.

E. When installed in accordance with all the provisions of this section and related sections, the warranty on the control panel shall be seven (7) years against defects in materials and or workmanship. The warranty shall be in printed form, included with the product submittal, and previously published as the manufacturer's standard warranty for all similar units manufactured.

1. The warranty period shall start from the date of equipment delivery to the job site.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Storage of Materials and Equipment:

1. Contractor shall store material and each piece of equipment in accordance with the manufacturer's recommendation for protection from weather, temperature, and moisture contamination.

B. Handling Materials and Equipment:

1. Material shall be handled in a manner such as to eliminate the possibility of damage, breakage, or chipping in transit or otherwise.

PART 2 PRODUCTS

2.01 SUBMERSIBLE PUMP

A. The pump(s) shall be a submersible sewage pump with integrated control system for wet well installation and is based on Flygt NP 6020 Concertor.

B. The pump shall be equipped with a 10 HP submersible synchronous electric motor, capable to operate on a 380 to 480 volt, 3 phases, 50 or 60 hertz voltage supply. The starting current shall not exceed 14 A.

C. The hydraulic of the pump shall be capable of handling raw domestic wastewater with fibrous materials like wet wipes.

D. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The insert ring shall have a guide pin which moves fibers from the center of the impeller to the leading edges of the impeller. The impeller shall move axially upwards to allow larger debris to pass through and immediately return to normal operating position. The clearance between the insert ring and the impeller leading edges shall be adjustable.

E. Due to the likely presence of sand and or grit the impeller and the cutting ring shall be made of ASTM A532 Alloy III A with 25% chrome. Impellers that have surface hardening or coating will not be allowed.

F. The pump shall be capable to operate without any limitation between 50% and 150% of the Best Efficiency Point (BEP) of the performance curve.

G. The pump the motor and the integrated control system shall be submersible a minimum of 65 feet (20m) according to IEC 60034 and protection class IP 68. Motors which only can be submerged for a limited time (IP 67) shall not be considered as equal.

H. The motor shall be capable to operate the pump at continuous duty (S1) in an ambient temperature up to 104°F. Operational restrictions or the demand of auxiliary cooling systems like fans or blowers are not acceptable.

I. The pump shall be operated by a synchronous motor and an integrated control system and be capable to run at constant power at any point of the performance field without being overloaded. Motor shall utilize a permanent magnet rotor to maintain synchronous speed.

J. The motor shall withstand at least 60 starts per hour.

K. The discharge flange of the pump shall be 4-inches in diameter and drilled according to ANSI B16.1-89; tab.5.

L. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

M. An integrated pump control system installed in the pump/motor housing shall start the pump by gradually increasing the pump speed. The starting current shall not be higher than the rated current.

N. An integrated pump control system installed in the pump/motor housing shall secure that the direction of the impeller rotation is always correct. There shall be no need for any human intervention to ensure that the impeller is rotating in the correct direction within the volute. The integrated control system shall be inside the motor and encapsulated to protect it against moisture ingress, and vibration.

O. The motor and the pump control system shall receive sufficient cooling from the pumped liquid to operate the pump at continuous duty in a liquid with a temperature with 104°F. Operational restrictions on the liquid temperature below 104°F or the demand of auxiliary cooling systems like fans or blowers are not acceptable. The Stator shall be inverter duty rated in accordance with NEMA MG1, Part 31 and be insulated according to Class H (356°F).

P. Motor, pump and control system shall be designed and supplied by the pump manufacturer.

Q. The control system shall continuously monitor the leakage sensor in the stator housing and the temperature of the motor. It shall be impossible to overload the motor. If the motor temperature is too high, the pump shall continue to operate at reduced power until conditions are normalized. External trips or overload devices for motor protection shall not be required.

R. The operator shall be able to modify the setting of the control system to decide if the active leakage signal shall stop or not stop the pump.

S. The pump shall incorporate a “pump-cleaning” function to remove debris from the impeller.The cleaning function shall be initiated when the integral control system senses an increase in current draw due to debris in the pump. The cleaning function shall consist of forced stopping, reversal and forward runs timed to allow for debris to fall from the impeller. After cleaning cycle is complete, the pump shall resume to automatic operation. If the pump impeller/volute does not clear itself after the programmed number of attempts, the control shall initiate and alarm to notify that the pump inlet / volute is blocked by large debris.

T. It shall be possible to access and adjust the pump system with a Human Machine Interface (HMI) ranging from basic monochrome displays to full-color touch screen units and smartphone or tablet. It shall enable the operator to view and control entire pump system and logged

operational data like number of starts, avoided clogging instances, pump run-time, motor power, motor current, power factor, temperature, pump leakage etc.

U. The shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single row ball bearing to handle radial loads. The lower bearing shall be a double row angular contact ball bearing to handle the thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump performance field.

V. The shaft shall be sealed by a tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal function.

W. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

X. Materials of construction shall be as follows:

1. Pump housing: ASTM A48, Class 35B
2. Impeller and insert ring: A532 ALLOY III A (25% chrome)
3. Stator housing: GD-AL SI 12 or ASTM B85A 413
4. Shaft: ASTM A479 S43100-T.
5. Shaft seal: Pump side: Corrosion resistant Tungsten carbide WCCR
6. Shaft seal Motor side: Corrosion resistant Tungsten carbide WCCR

Y. Castings must be blasted before coating. Wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Z. The motor shall be equipped with 50 feet of screened cable S3x6+3x6/3+S(4x0,5) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 65 feet.

AA. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment:

1. Hydraulic performance test
2. No-Leak seal integrity test

BB. In case the pump manufacturer cannot meet the specified performance and control functions with a pump model, the control panel shall be equipped with Adjustable Speed Drives (ASD) with bypass starters and a PLC programmed to meet the above specified performance field, housed in an enclosure equipped with fans, louvers sized to ensure proper ASD operation. Five (5) spare louver filters and one (1) spare fan shall be provided per panel.

2.02 XPC GATEWAY APP 411

A. The station controller shall have the following features, at a minimum:

1. Hand-off auto switch for each Pumping System (CPS)
2. User configurable liquid level setpoints for CPS activation and deactivation.
3. User configurable liquid level alarm setpoints for high level.

4. Alternation options include:
5. Inputs and outputs:
    a. Four (4) zero-volt digital inputs
    b. Four (4) relay outputs rated at 250V or 30VDC, 5 amps.
    c. One (1) analog input 24VDC max
    d. One (1) analog output 24VDC max.
6. The following station optimization features shall be pre-configured:
    a. Fat buildup minimization feature that uses a random lead pump start delay timer. The timer shall be initially set to 60 seconds.
    b. A sump and pipe cleaning function that will run the CPS to the snore point based on an operator configurable number of pump cycles. The number of cycles shall be initially set to 11.
    c. The CPS shall automatically detect a blockage and automatically clear the blockage. The station controller shall monitor the status and annunciate an alarm should the blockage not be cleared.
    d. The station controller shall have an energy minimizer function that minimizes the amount of energy used per pumping cycle.
7. Integrated data logger with:
    a. Capacity for recording up to 4,000 events
    b. Ability to download events to a USB storage device
8. Provide ethernet to fiberoptic switch.
9. Monitoring of output current, power level, speed, and motor temperature
10. Faults on the controller shall be configurable for:
    a. Acknowledgement Required
    b. Three (3) levels of priority
    c. Automatically resetting fault

2.03 HUMAN MACHINE INTERFACE (HMI)

A. A display compatible with the pump station manager and shall have the following features at a minimum:
    1. Home screen displayed parameters must include:
        a. Pump status for each pump including:
            1) Pump running.
            2) Pump is in the HAND position.
            3) Pump is in the OFF position.
            4) Pump is in the AUTOMATIC position.
            5) Pump is available to run.
            6) Pump fault
        b. Pump alternation active indicator.
    2. Information Screen that show the following information:

a. Hours Run counter for each pump:
    1) total time today, total time yesterday
    2) total time this week
    3) total accumulated hours since last commissioning
b. Pump Start counter for each pump:
    1) pump starts today, pump starts yesterday
    2) pump starts this week, total accumulated pump starts
    3) power in kW
c. I/O Status:
    1) Digital I/O status
    2) Analog I/O status with a value in (mA)

3. Ability to configure the controller without a laptop and configure the following parameters at a minimum:
    a. Set point programming of pump activation/deactivation values and level alarm values
    b. Enable/Disable level alarms, faults and historical data recording
    c. Configuration of Inputs and Outputs
    d. Configure station optimization parameters
    e. Configure communications parameter
    f. Create or restore backup copies of the pump controller configuration settings
    g. Factory reset the controller

B. A touchscreen display may be supplied, in lieu of, or in conjunction with the keypad display, and must have the following features at a minimum:
1. 7-inch touchscreen with the following minimum capabilities:
    a. Built in web browser
    b. multi-touch screen
    c. Dual core process @ 8MHz
    d. 512 MB Flash and 1GB Ram
    e. Fan-less design
    f. IP65 front panel
    g. Power: 12-24VDC @8.5W
    h. Resolution: 800x480
    i. Operating temperature: 0-60C

2.04 PUMPING SYSTEM GATEWAY

A. The sump shall be equipped with a Multi-Stage Level Sensing Device or a Level transmitter designed to detect level of the waste water for pump control and liquid level display (Flygt LTU 801).

B. The Multi-Stage Level Sensing Device shall be PVC injected to seal the unit and prevent any moisture from entering any of the sensor units. Each sensor on the probe shall be rotated 90 degrees horizontally from the previous sensor along the probe length to eliminate tracking

between sensors. Level sensing probes shall be pressure injected with an epoxy resin at final assembly to encapsulate all internal components and connections, thereby creating a rigid, sealed, homogeneous unit. Two wires shall be included within the length of the probe and shall be connected to each other at the bottom of the probe. When the wires are connected to the Pump station Controller, the connection shall provide fail-safe monitoring of the probe cable and the probe assembly. The flexible cable used for the Level Sensing Probe shall be comprised of PVC/PVC multi-conductor construction with a common oversheath that is water and oil resistant. The multi-conductor cable shall be identified with numbering and text along the entire length of the outer sheath at required intervals.

C. The Level transmitter shall measure the relative pressure with a ceramic diaphragm and be approved acc. EN 61000-6-2, EN 61000-6-3, EN 61326-1. It shall be insulated > 100 MΩ at 500 V DC and the sensor body shall be made of Ryton PPS.

D. Sensors installed in the sump shall be approved for explosive areas according UL Class 1, 2 and 3 Division 1 Group A-D T4/T5/T6

E. Cables shall be secured to the top of probe bodies by synthetic rubber compression fittings for strain relief. The cable shall be rated to physically support the combined weight of the sensor and long enough to reach to reach the cable connection box.

F. The mounting bracket shall be by stainless steel and include a wiper device that allows maintenance personnel to clean the level sensing probe when necessary.

2.05 BACKUP UPS SYSTEM

A. The backup UPS shall be supplied with the following specifications:

B. Provide a 24VDC power supply with battery backup capable of running al DC loads for a minimum of 1 hour.

2.06 SURGE SUPPRESSION

A. A 240VAC or 480VAC three phase surge suppression device shall be installed in line with the supply voltage with the following features:

1. Each input shall have a nominal AC operating voltage of 240V for 240V supply or 277V for 480V supply
2. Meet UL 1449 4th edition requirements
3. Meet IEC 61643-11 requirements
4. Response time <1ms
5. Nominal discharge current: 20kA 8/20 µs
6. Maximum discharge current: 50kA 8/20 µs
7. Maximum surge capacity: 60kA 8/20 µs
8. Voltage protection rating: 1000V (240V) or 1500V (480V)
9. Voltage protection level: 1300V (240V) or 1700V (480V)
10. Residual voltage at 10kA (8/20 µs): 1395V
11. Operating frequency range: 0-500Hz
12. Operating temperature: -40ºC to +85ºC

2.07 HAZARDOUS LOCATION PROTECTIVE DEVICE

A. The Hazardous Area Protective Device is intended to protect equipment and personnel in areas where hazardous conditions may be present.

B. The intrinsically safe device shall be supplied according to the following:

1. The intrinsically safe barrier shall be panel mounted and designed to protect a ball float inputs and level transducer inputs.
2. The barrier shall be certified intrinsically safe for use with equipment in installations up to and including Class 1 Zone O.
3. The intrinsically safe barrier shall have screw terminals for wire connections.
4. The intrinsically safe barrier shall be protected and current limited according to the requirements of UL Class I (Groups A, B, C & D), Class II (Groups E, F, & G) and Class III certification.
5. The device shall also be CE and CSA listed for applicable locations and shall allow a maximum short circuit current of 10 ma.
6. The intrinsically safe barrier shall be surface mounted using the mounting flanges on either side of the unit assembly.
7. The unit shall be fastened with approved screws or bolts in accordance with UL requirements.

2.08 WET WELL SUBMERSIBLE PRESSURE TRANSDUCER

A. Design based on Vegawell 52 with lightning protector. Approved equal by Keller Level Rat or Contegra SLX.

B. Provide 50' suspension cor. Calibrate 0 - 10'.

C. Level transducer must be UL or FM approved for installation in Class 1, Division 1, Group D, Hazardous Area Installation.

2.09 FLOAT SWITCHES

A. Hermetically sealed mechanical tilt with 60-foot suspension cable rated at a minimum of 13 ampere at 120-volt AC.

B. SPST contact.

C. Corrosion resistant poly-propylene float, leakproof, shockproof, and corrosion resistant to sewage.

D. Shorter length suspension cords may be furnished provided they have sufficient length to reach junction box without splice.

E. Design based on Gems/Warrick MBLU60W and MYEL60W. Approved equal features and product by Connery or SJE.

2.10 CONTROL PANEL CONSTRUCTION & ASSEMBLY

A. General:

1. Control panels shall be manufactured in accordance with the UL 508 standard or UL 698A and shall be so constructed for the application of a UL listing label by an approved UL control panel assembly facility.
2. Control panel wiring shall be installed and arranged in an organized, efficient manner. Wiring shall be inspected for safety and verified by performing a point-to-point test.
3. Electrical connections shall be properly inspected and torqued in compliance with the UL 508 standard or UL 698A standard. External connections to the control panel shall be by way of numbered terminal blocks.
4. Control panels shall be properly checked and load tested with power applied. A control panel test log shall be supplied with the control panel.
5. Control panels shall be supplied from a UL approved control panel assembly facility with all of the required labels properly attached.

B. Control Panel Enclosure:

1. Environmental Rating:

a. Control panel enclosure rating shall be specified in accordance with the project requirements or the contract drawings as 4x (stainless steel).

2. Enclosure Condensation Heater:

a. Provide a 120vac, 100 watt enclosure heater inside the control panel.

b. Heater shall be a silicone rubber, insulated strip type enclosure heater.

c. Heater shall be Hoffman Model DAH1001AP or approved equal.

C. Wiring Requirements:

1. Wiring for AC and DC control circuits shall be type sis or type MTW stranded copper and shall be sized for the applied voltage and current. Unless otherwise noted, control circuit wiring shall not be smaller than 16 AWG.

2. Cable wiring for analog signal circuits shall be twisted, shielded pairs of stranded copper conductors that shall not be smaller than 20 AWG.

3. Wiring for special signaling equipment such as communications, digital data, and multiplexed signals shall be provided by the equipment supplier.

4. Wiring shall be numbered and marked at each termination point.

5. Terminal blocks for internal or external wiring shall be din rail mounted, individual screw compression type terminals with machine printed labels.

D. Grounding:

1. Control panel enclosure shall be properly grounded in accordance with the national electrical code and local code requirements.

2. Each analog signal loop shall only have its shield wire connected to ground at a single point for the loop. Shields shall be grounded at control panels where signals are input to the receiving device and not at the source of the transmitting device.

E. Local Alarm:

1. There shall be a flashing alarm light mounted on top of the control panel enclosure for local alarm indication. The flashing alarm light shall be supplied according to the following specifications:

2. 2. UL recognized for use with UL NEMA type 4x &12 enclosures.

3. Shatter resistant Lexan globe, UV Stabilized and flame retardant.

4. The flashing alarm light shall be by Ingram products or approved equal.

F. Electrical Transient (Surge) Protection:

1. Electrical and electronic components of the control panel shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and surges in nearby electrical systems.

2. The transient surge protector shall be rated for 25ka per phase or larger.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

A. Pump(s):

1. Examine base and verify size of base end anchor bolt positioning. Rectify 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 for proper positioning, alignment, and anchorage.

2. Engineer shall observe proper mating of each pump with the base flange when lowered on guide rails.

3.02 INSTALLATION

A. Pump(s):

1. Each pump shall be supplied with a mating cast iron discharge connection. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two stainless steel guide bars extending from the top of the station to the discharge connection to ensure pump stability when installing or removing the machine. There shall be no need for personnel to enter the wet well to access the pump. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing off the discharge interface with a diaphragm, O-ring or profile gasket shall not be acceptable. No portion of the pump shall bear directly on the wet well floor.

2. Each pump shall be fitted with stainless steel lifting chain. Lifting chain shall be connected to the lifting handle of the pump and be long enough to reach the top elevation of the station. Lifting chain shall be compatible with the Grip-Eye Pump Lift System. The working load of the lifting system shall be 50% greater than the pump unit weight.

3. One pump lift system Grip-Eye shall be provided for each pump station. The Grip-Eye shall allow for utilizing the hoist for lifting each pump from its installed position to above the top elevation of the station. The Grip-Eye device shall be configured to slide down the stainless steel lifting chain and grip the lifting chain near pump handle. The retrieval system shall be appropriately sized for the weight of the pump to be lifted.

4. Submersible cable connection box acc. NEMA 6P

5. The submersible cable of the pump shall be connected to the wall mounted power and monitoring cables in a cable connection box to ease the installation and disassembling of the pumps.

6. The cable connection box shall be submersible NEMA 6P (IP 67) to secure that no water can enter the motor via the cables even when the complete station is flooded.

3.03 POINT TO POINT I/O VERIFICATION

A. General:

1. After installation of the pumps and the control panel, a factory trained technician shall prepare the I/O checklist. The checklist shall include the following:

   a. Inputs and outputs connected to the control panel

   b. Alarms that can be generated by the control panel

2. The technician shall follow a test procedure to test all I/O and alarms.

   a. Digital inputs shall be tested from point of origin unless it is unsafe.

   b. Digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.

   c. Analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.

   d. Analog outputs shall be tested by running a simulation program or by forcing the output to a value.

3. The technician shall follow a test procedure to ensure the system operation parameters are met.

B. Configuration Verification:

1. The factory trained technician shall document the settings using a factory provided configuration checklist. Each parameter shall be verified prior to the beginning of testing and then again after testing is completed.

2. The configuration of the pump station manager as well as the IPS gateways shall be documented.

3. The pump station manager configuration shall be saved to a factory provided SD card after testing is completed.

3.04 FIELD QUALITY CONTROL

A. The general requirements for system testing, check out, initial start-up, certification, and instruction of plant personnel are contained in Section 01 60 00 and Section 01 77 00.

B. Factory Trained Supervision:

1. Contractor shall procure a factory trained technician to check over equipment prior to putting the equipment into operation.

2. Point to point test of all wiring.

3. Functional test of all equipment alarms and controls.

C. Certification of Testing:

1. Tests shall be performed in the presence of the Engineer a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.

2. Written notice of all tests shall be given two weeks in advance.

3. All test equipment shall be provided by the Contractor.

D. Provide additional services at no cost to the Owner to correct any operational problems as determined by the Engineer or Contractor.

3.05 PUMP WARRANTY

A. Contractor shall supply the pump manufacturer’s warranty against defects in workmanship and material for a period of two (2) years from the date of Substantial Completion.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. General construction and requirements.

B. Applications.

C. Three phase electric motors.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.

C. NEMA MG 1 - Motors and Generators 2018.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 WARRANTY

A. See Section 01 77 00 - Closeout Procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:

1. Motors Larger than 1/2 Horsepower: 480 volts, three phase, 60 Hz.

B. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

B. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.

2.04 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

H. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

3.02 SCHEDULE

A. Three Phase - Energy Efficient, Totally Enclosed, Fan Cooled Performance:

1. 1200 rpm.
    a. 1 hp:
        1) NEMA Frame: 145T.
        2) Minimum Percent Power Factor: 72.
        3) Minimum Percent Efficiency: 81.
    b. 1-1/2 hp:
        1) NEMA Frame: 182T.
        2) Minimum Percent Power Factor: 73.
        3) Minimum Percent Efficiency: 83.
    c. 2 hp:
        1) NEMA Frame: 184T.
        2) Minimum Percent Power Factor: 68.
        3) Minimum Percent Efficiency: 85.
    d. 3 hp:
        1) NEMA Frame: 213T.
        2) Minimum Percent Power Factor: 63.
        3) Minimum Percent Efficiency: 86.
2. 1800 rpm.
    a. 1 hp:
        1) NEMA Frame: 143T.
        2) Minimum Percent Power Factor: 84.
        3) Minimum Percent Efficiency: 82.
    b. 1-1/2 hp:
        1) NEMA Frame: 145T.
        2) Minimum Percent Power Factor: 85.
        3) Minimum Percent Efficiency: 84.

c. 2 hp:

1) NEMA Frame: 145T.

2) Minimum Percent Power Factor: 85.

3) Minimum Percent Efficiency: 84.

d. 3 hp:

1) NEMA Frame: 182T.

2) Minimum Percent Power Factor: 83.

3) Minimum Percent Efficiency: 87.

END OF SECTION

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 05 50 00 - Metal Fabrications

1.03 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

D. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. MFMA-4 - Metal Framing Standards Publication 2004.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.06 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

D. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.

2. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.

3. Indicate proposed arrangement of distributed system trapeze support groupings.

4. Indicate proposed locations for distributed system flexible fittings and/or connections.

5. Indicate locations of seismic separations where applicable.

6. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Evidence of qualifications for manufacturer.

H. Manufacturer’s detailed field testing and inspection procedures.

I. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:

1. Select vibration isolators to provide required static deflection.

2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

3. Select vibration isolators for outdoor equipment to comply with wind design requirements.

4. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D. Equipment Isolation:

1. Equipment Type: Fan.

a. Isolator Type (Non-seismic Application): Restrained spring isolators.

E. Thrust Restraint Applications:

1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.

2. Minimum Static Deflection: Same as static deflection of equipment.

3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.02 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:

a. Kinetics Noise Control, Inc

b. Mason Industries

c. Vibration Eliminator Company, Inc.

d. Vibro-Acoustics

e. Substitutions: See Section 01 60 00 - Product Requirements.

2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

2. Spring Elements for Spring Isolators:

a. Color code or otherwise identify springs to indicate load capacity.

b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.

c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.

d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.

e. Selected to provide designed deflection of not less than 75 percent of specified deflection.

f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Non-seismic Applications:

1. Resilient Material Isolator Pads:

a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.

b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.

c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2. Resilient Material Isolator Mounts, Non-seismic:

a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.

3. Open (Unhoused) Spring Isolators:

a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.

b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.

c. Furnished with integral leveling device for positioning and securing supported equipment.

4. Housed Spring Isolators:

a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.

b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.

c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.

d. Furnished with integral leveling device for positioning and securing supported equipment.

5. Restrained Spring Isolators, Non-seismic:

a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.

b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.

c. Furnished with integral leveling device for positioning and securing supported equipment.

d. Provides constant free and operating height.

6. Resilient Material Isolator Hangers, Non-seismic:

a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.

7. Spring Isolator Hangers, Non-seismic:

a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.

b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

8. Combination Resilient Material/Spring Isolator Hangers, Non-seismic:

a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.

b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

9. Thrust Restraints:

a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Engineer in accordance with Section 01 45 33 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.

1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.

2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:

1. Spring Isolators:
    a. Position equipment at operating height; provide temporary blocking as required.
    b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
2. Isolator Hangers:
    a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
3. Thrust Restraints:
    a. Adjust restraint movement under normal operating static pressure.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.04 FIELD QUALITY CONTROL

A. See Section 01 45 00 - Quality Control, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D. Vibration Isolation Systems:
    1. Verify isolator static deflections.
    2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

C. Vibration measurement of equipment operating conditions.

D. Commissioning activities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 08 00 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Engineer.
2. Submit to the Commissioning Authority.
3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Engineer and other installers to sufficiently understand the design intent for each system.
5. Include at least the following in the plan:
    a. Preface: An explanation of the intended use of the control system.
    b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    d. Identification and types of measurement instruments to be used and their most recent calibration date.
    e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    f. Final test report forms to be used.
    g. Detailed step-by-step procedures for TAB work for each system and issue, including:

1) Terminal flow calibration (for each terminal type).

2) Diffuser proportioning.

3) Branch/submain proportioning.

4) Total flow calculations.

5) Rechecking.

6) Diversity issues.

h. Expected problems and solutions, etc.

i. Details of how TOTAL flow will be determined; for example:

1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.

j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.

k. Confirmation of understanding of the outside air ventilation criteria under all conditions.

l. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).

m. Method of checking building static and exhaust fan and/or relief damper capacity.

n. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.

o. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

p. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least twice a week to the Commissioning Authority.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

6. Include the following on the title page of each report:

a. Name of Testing, Adjusting, and Balancing Agency.

b. Address of Testing, Adjusting, and Balancing Agency.

c. Telephone number of Testing, Adjusting, and Balancing Agency.

d. Project name.

e. Project location.

f. Project Engineer.

g. Project Contractor.

h. Project altitude.

i. Report date.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of three years documented experience.

3. Certified by one of the following:

a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.

b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

E. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Access doors are closed and duct end caps are in place.

8. Air outlets are installed and connected.

9. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

3.04 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.05 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Measure air quantities at air inlets and outlets.

C. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

D. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

E. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.06 COMMISSIONING

A. Perform prerequisites prior to starting commissioning activities.

B. Fill out Prefunctional Checklists for:

1. Water side systems.

C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

D. In the presence of the Commissioning Authority, verify that:

1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.

2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3.07 SCOPE

A. Test, adjust, and balance the following:

1. Fans.

3.08 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. HP/BHP.
3. Phase, voltage, amperage; nameplate, actual, no load.
4. RPM.
5. Service factor.
6. Starter size, rating, heater elements.
7. Sheave Make/Size/Bore.

B. Exhaust Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

C. Duct Leak Tests:

1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test static pressure.
7. Test orifice differential pressure.
8. Leakage.

D. Vibration Tests:

1. Location of points:
    a. Fan bearing, drive end.
    b. Fan bearing, opposite end.
    c. Motor bearing, center (if applicable).
    d. Motor bearing, drive end.
    e. Motor bearing, opposite end.
    f. Casing (bottom or top).
    g. Casing (side).
    h. Duct after flexible connection (discharge).
    i. Duct after flexible connection (suction).
2. Test readings:
    a. Horizontal, velocity and displacement.
    b. Vertical, velocity and displacement.
    c. Axial, velocity and displacement.
3. Normally acceptable readings, velocity and acceleration.
4. Unusual conditions at time of test.
5. Vibration source (if non-complying).

END OF SECTION

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

B. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:

1. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

C. Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).

1.03 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

C. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:

1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    a. Floor.
    b. Room number.
    c. Room name.
    d. Air handler unit ID.
    e. Reference drawing number.
    f. Air terminal unit tag ID.
    g. Heating and/or cooling valve tag ID.
    h. Minimum air flow rate.
    i. Maximum air flow rate.

5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    a. Sequences of operation.
    b. Control drawings.
    c. Points lists.
    d. Controller and/or module data.
    e. Thermostats and timers.
    f. Sensors and DP switches.
    g. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

D. Project Record Documents:
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

E. Draft Training Plan:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

F. Training Manuals:
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with Contract Documents.

3.02 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two-way radios for use during the testing.

D. Valve/Damper Stroke Setup and Check:

1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

E. Isolation Valve or System Valve Leak Check: For valves not by coils.

1. With full pressure in the system, command valve closed.
2. Use an ultra-sonic flow meter to detect flow or leakage.

F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.

B. Coordinate commissioning schedule with TAB schedule.

C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.

D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.

F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.

B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.

C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.

1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.

2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.

E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.

F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.

1. Setpoint changing features and functions.

2. Sensor calibrations.

G. Demonstrate to the Commissioning Authority:

1. That all specified functions and features are set up, debugged and fully operable.

2. That scheduling features are fully functional and setup, including holidays.

3. That all graphic screens and value readouts are completed.

4. Correct date and time setting in central computer.

5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.

6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.

7. Power failure and battery backup and power-up restart functions.

8. Global commands features.

9. Security and access codes.

10. Occupant over-rides (manual, telephone, key, keypad, etc.).

11. O&M schedules and alarms.

12. Occupancy sensors and controls.

13. All control strategies and sequences not tested during controlled equipment testing.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS

A. Add design intent documentation furnished by Engineer to manuals prior to submission to Owner.

B. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING

A. See Section 01 79 00 for additional requirements.

B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.

D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:

E. TAB Review: Instruct Owner's personnel for minimum 4 hours, after completion of TAB, on the following:

1. Review final TAB report, explaining the layout and meanings of each data type.

2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.

4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:

1. Phase 1 - Basic Control System: Provide minimum of 4 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.

a. This training may be held on-site or at the manufacturer's facility.

b. If held off-site, the training may occur prior to final completion of the system installation.

c. For off-site training, Contractor shall pay expenses of up to two attendees.

2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 4 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:

a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.

b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.

d. Every display screen, allowing time for questions.

e. Point database entry and modifications.

3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 4 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.

H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Metal ducts.

B. Flexible ducts.

C. Nonmetal ducts.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC

B. Section 23 33 00 - Air Duct Accessories

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASHRAE Std 126 - Method of Testing HVAC Air Ducts 2020.

D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.

E. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2023.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2023.

G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

I. ICC (IMC) - International Mechanical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements 2018, with Editorial Revision (2020).

K. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry 2018, with Editorial Revision (2020).

L. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2017, with Editorial Revision (2020).

M. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2023.

N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

O. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2021.

P. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids 2020.

Q. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

R. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual 2012.

S. SMACNA (RIDC) - Rectangular Industrial Duct Construction Standards 2007.

T. SMACNA (ROUND) - Round Industrial Duct Construction Standards 2013.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.

D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceed specified requirements.

E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).

F. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

G. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.07 WARRANTY

A. See Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.

C. Duct Shape and Material in accordance with Allowed Static Pressure Range:

1. Round: Plus or minus 2 in-wc of stainless steel.
2. Rectangular: Plus or minus 2 in-wc of stainless steel.
3. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc

D. Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
    a. Supply Air: 1 in-wc pressure class, stainless steel.
    b. Outside Air Intake: 1 in-wc pressure class, stainless steel.

c. General Exhaust Air: 1 in-wc pressure class, stainless steel.

2. Low Pressure Service: Up to 2 in-wc:

a. Seal: Class C, apply to seal off transverse joints.

b. Leakage:

1) Rectangular: Class 24 or 24 cfm/100 sq ft.

2) Round: Class 12 or 12 cfm/100 sq ft.

3. Low Pressure Service: From 2 in-wc to 3 in-wc:

a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.

b. Leakage:

1) Rectangular: Class 12 or 12 cfm/100 sq ft.

2) Round: Class 6 or 6 cfm/100 sq ft.

4. Medium and High Pressure Service: Above 3 in-wc:

a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.

b. Leakage:

1) Rectangular: Class 6 or 6 cfm/100 sq ft.

2) Round: Class 3 or 3 cfm/100 sq ft.

E. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.

2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.

3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.

4. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

5. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.02 METAL DUCTS

A. Material Requirements:

1. Stainless Steel: ASTM A666, Type 304.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. Comply with safety standards NFPA 90A and NFPA 90B.

D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use double nuts and lock washers on threaded rod supports.

I. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

J. Painting: Provide surface finish as indicated on Drawings. 23.

3.02 CLEANING

A. Clean thoroughly each duct system.

B. Clean duct system by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Backdraft dampers - metal.

B. Backdraft dampers - fabric.

C. Duct test holes.

D. Flexible duct connectors.

E. Low leakage (Class 1A) control dampers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

B. Section 23 31 00 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.04 SUBMITTALS

A. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct test holes, and hardware used. Include electrical characteristics and connection requirements.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

C. Project Record Drawings: Record actual locations of test holes.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 BACKDRAFT DAMPERS - METAL

A. Manufacturers:

1. Ruskin Company
2. Approved equal

B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 BACKDRAFT DAMPERS - FABRIC

A. Fabric Backdraft Dampers: Factory-fabricated.

1. Blades: Neoprene coated fabric material.
2. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.03 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

1. Manufacturers:
   a. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal
   b. Approved equal

2.04 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.
2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick stainless steel.

2.05 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Manufacturers:

1. Ruskin Company; CD50: www.ruskin.com/#sle.
2. Approved equal..

B. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.

C. Frame:

1. Material: 20-gauge 316 stainless steel.
2. Free-area: Single cross section.

D. Blade:

1. Type: Single-blade rectangle shape.
2. Operation: Opposed type.
3. Maximum Individual Blade Height: 8 inches.
4. Material: 12-gauge 316 stainless steel.
5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).

E. Temperature Service Range: Minus 25 to 185 degrees F.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS).

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

END OF SECTION

SECTION 23 34 16
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Backward inclined centrifugal fans.

B. Forward curved centrifugal fans.

C. Radial centrifugal fans.

D. Bearings and drives.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.

C. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014 (Reaffirmed 2020).

C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.

D. AMCA 99 - Standards Handbook 2016.

E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.

F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.

H. NEMA MG 1 - Motors and Generators 2018.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

1.04 SUBMITTALS

A. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point plotted, power, rpm, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

B. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Include complete installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fan Belts: One set for each individual fan.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD CONDITIONS

A. Permanent fans may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ACME Engineering and Manufacturing Corporation

B. Loren Cook Company

C. Greenheck Fan Corporation

D. Approved equal

2.02 PERFORMANCE REQUIREMENTS

A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Comply with AMCA 99.

D. Performance Base: Sea level conditions.

2.03 WHEEL AND INLET

A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and backplate; cast iron hub riveted to back plate and keyed to shaft with set screws.

B. Forward Curved: Black enameled steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and back plate; steel hub swaged to backplate and keyed to shaft with set screw.

C. Radial: Steel construction with inlet flange, heavy reinforced back plate, plate blades with reinforcing gussets welded or riveted to back plate and flange; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

2.04 BEARINGS AND DRIVES

A. Bearings: Heavy duty pillow block type, self-greasing ball bearings, with ABMA STD 9 life at 50,000 hours.

B. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard.

C. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under, selected so required rpm is obtained with sheaves set at mid Fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

D. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.05 ACCESSORIES

A. Discharge Dampers: Parallel blade heavy-duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.

B. Access Doors: Shaped to fit scroll, with quick opening latches and gaskets.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fans with resilient mountings and flexible electrical leads, see Sections 23 05 48 - Vibration and Seismic Controls for HVAC.

C. Install flexible connections between fan inlet and discharge ductwork; see Section 23 33 00 - Air Duct Accessories. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install fan restraining snubbers; see Sections 23 05 48 - Vibration and Seismic Controls for HVAC. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

END OF SECTION

SECTION 23 82 00
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Electric unit heaters.

1.02 RELATED REQUIREMENTS

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

1.03 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Current Edition.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

F. UL 674 - Electrical Motors and Generators for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Provide typical catalog of information including arrangements.

B. Shop Drawings:

1. Submit the following for valance heating and cooling units indicating:
    a. Scaled layouts showing valance type, capacity, coil and panel lengths.
    b. Installation and construction details for all valance types.
    c. Location drawings for mounting heights.
2. Indicate mechanical and electrical service locations and requirements.

C. Manufacturer's Instructions: Indicate installation instructions and recommendations.

D. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

F. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.05 QUALITY ASSURANCE

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

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 ELECTRIC UNIT HEATERS

A. Manufacturers:

1. Modine Manufacturing Company
2. Trane Technologies, PLC
3. Approved equal

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.

C. Heating Element Assembly:

1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
2. Horizontal Projection Units:
    a. Steel fins copper brazed to steel sheath and epoxy sealed for moisture resistance.
    b. Nickel chromium resistance wire surrounded with magnesium oxide and sheathed in steel, spiral-finned tubes.

D. Housing:

1. Suitable for ceiling or high-altitude mount using provided hardware appendages.
2. Horizontal Projection Units:
    a. Construction materials to consist of heavy gauge steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
    b. Provide with threaded holes for threaded rod suspension.
    c. Provisions for access to internal components for maintenance, adjustments, and repair.
    d. Watertight construction for high moisture, corrosive prone washdown spaces.

E. Air Inlets and Outlets:

1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.

F. Fan: Factory balanced, direct drive, axial type with fan guard.

G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.

H. Controls:

1. Fan override to purge residual heat when de-energized.
2. Built-in line-voltage thermostat.

I. Electrical Characteristics:

1. Disconnect Switch: Factory mount disconnect switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Unit Heaters:

1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.

2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

3.03 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish labor, material, and equipment required for the installation of the electrical systems, modifications to existing electrical systems, and the completion of the work as herein specified and/or indicated on the Drawings. It is the intent that the Drawings and Specifications, which are general only, shall provide for finished, first-class work, and that the equipment and appurtenances thereto shall be of such construction and details, and of such materials, as to function completely and properly, and so as to be of long life; and such as not to require excessive upkeep or maintenance; and that operation shall be simple and control convenient. Any items omitted therefrom which are clearly necessary for the completion of the work or its appurtenances shall be considered a portion of the work though not directly specified or shown. Work shall conform with NECA 1, Standards Good Workmanship in Electrical Construction.

B. Contractor shall install and wire remote mounted heating and ventilating thermostats, electrical components, and control panels furnished by the equipment suppliers in accordance with other Sections of these Specifications.

C. Contractor shall install and wire electric resistance heaters and any associated, remote mounted thermostats furnished under other Sections of these Specifications.

D. Contractor shall provide and install conduit and wire connections required between components of equipment and systems supplied under other Sections of these Specifications, where shown or indicated on the Contract Drawings.

E. Contractor shall furnish and install complete secondary power distribution systems and modifications to existing secondary power distribution systems.

F. Contractor shall furnish and install a complete lighting system.

G. Contractor shall furnish and install complete auxiliary systems and existing auxiliary system modifications, as specified herein and as shown on the Contract Drawings.

1.02 DESCRIPTION OF SYSTEMS

A. Existing medium voltage power for the pump shall be 4160 volts, 3 phase, 3 wire plus ground, supplied from the existing medium voltage VFD.

B. Existing secondary power shall be 480 volts, 3 phase, 3 wire plus ground, 60 Hertz supplied from the existing MCC.

C. Lighting system shall be 120/208 volts, 3 phase, 4 wire plus ground, 60 Hertz supplied from the existing lighting panel.

PART 2 PRODUCTS

2.01 GENERAL

A. Contractor shall furnish and install modifications to the existing power distribution system, together with necessary supports, framing, hangers, and other appurtenances. Contractor shall furnish and arrange for the setting of anchor bolts, channels, etc. which are to be set in the concrete. Contractor shall connect and make operable electrical equipment whether or not it was furnished under other Sections of these Specifications. Work shall include, but is not limited to, the following items:

1. Modifications to existing Variable Frequency Controllers
2. Electrical Equipment and Devices

3. Raceway System
4. Power Feeder and Branch Circuit Wiring
5. Modifications to Existing Motor Control Centers
6. Disconnect Switches
7. Surge Protection Devices
8. Grounding System

B. Contractor shall furnish and install a complete lighting system, together with necessary supports, framing, hangers, outlets, fixtures, panels, receptacles, and other appurtenances. Contractor shall furnish and arrange for the setting of anchor bolts, concrete inserts, etc. which are to be set in the concrete or in masonry walls. Work shall include, but is not limited to, the following items:

1. Modifications to existing Lighting Panelboards
2. Raceway System
3. Wiring
4. Wiring Devices and Hardware
5. Lighting Fixtures and lamps

PART 3 EXECUTION

3.01 DRAWINGS AND MEASUREMENTS

A. Outlets connected by lines show switch control or circuiting only and are not actual runs of conduit. Light and receptacle outlets are lettered and numbered; the letter indicates the panelboard from which the circuit is to be powered. Outlets bearing the same letter and number shall be connected to the same circuit.

B. Power feeders shall be run in individual conduits, from source to load, as indicated in schedules, wiring diagrams, or by home runs on the Drawings.

3.02 SHORT CIRCUIT, FLASH HAZARD, AND PROTECTIVE DEVICES COORDINATION ANALYSES

A. A power system short circuit analysis shall be provided by Contractor to analyze the electrical system and verify the correct application of the power system devices and other power system components provided under this Contract. This and the following flash hazard and coordination analyses shall be carried from the existing MCC through the branch circuit protective devices.

B. A flash hazard analysis shall be provided by Contractor to determine the flash protection boundary and the level of personal protective equipment (PPE) required for each switch enclosure, panel, device, and equipment containing electrical circuits per NFPA 70E . The results of this analysis shall be used to prepare arc-flash and shock hazard warning labels for electrical equipment enclosures, where required by the National Electrical Code.

C. A protective devices coordination analysis shall be provided by Contractor to analyze and verify the selection and settings of the protective devices in the electrical system. Devices shall be selected to provide a maximum of circuit protection and selectivity consistent with a maximum in service continuity. Composite coordination curves shall be provided by the Contractor to verify that selectivity will be provided by the devices used.

D. Provide six (6) bound documents, each of which shall include complete short circuit, flash hazard, and protective devices coordination analyses, including device coordination and time-current curves for the distribution system protective devices.

E. In the short circuit analysis, provide calculation methods and assumptions, the base quantities selected, one-line diagram, source impedance data (including power company system characteristics), impedance diagrams or data tables, typical calculations, tabulations of

calculated quantities and results, conclusions, and recommendations. Provide calculated short circuit interrupting and momentary duties for an assumed three phase bolted fault at the [primary switch, secondary switchboard, the primary switchgear, secondary unit substations, service entrance switch, automatic transfer switch, motor control centers, distribution panelboards, branch panelboards], and other significant locations throughout the [modified and added] distribution system. Include in the tabulations: fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit kva, and symmetrical and asymmetrical fault currents. Calculations shall be of the per unit impedance method on a 100 Mva or 1,000 kva base.

F. The flash hazard analysis shall include calculations of the flash protection boundary and incident energy for each piece of electrical equipment utilizing the formulas in NFPA 70E and IEEE 1584. The analysis results shall include the following for each piece of electrical equipment:

1. Nominal System Voltage
2. Arc Flash Boundary in inches.
3. Available Incident energy and the corresponding working distance in calories per square centimeter (cal/cm^2) and/or minimum arc rating of clothing and/or site-specific level of PPE.
4. Limited approach distance (when door or cover is open) in inches.
5. Restricted approach distance (when door or cover is open) in inches.

3.03 SEQUENCE OF CONSTRUCTION AND DEMOLITION

A. Contractor shall be responsible for coordinating and scheduling work to minimize disruption of Owner's facility operations. Contractor shall schedule service interruptions at times as approved by Owner and shall notify Owner, at least 24 hours in advance, of any scheduled power interruption during construction.

B. Contractor shall include details of the sequencing of the above work in a schedule of work. The schedule of work shall include work to be performed relative to time of material delivery and length of time for installation and shall be coordinated with permissible outage times as determined by Owner. The schedule shall be submitted for approval prior to the start of work.

END OF SECTION

SECTION 26 05 10
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Requirements specified in Section 26 05 00 - 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 01 33 00 - Submittal Procedures

B. Section 01 77 00 - Closeout Procedures

C. Section 03 30 00 - Cast-in-Place Concrete

D. Section 26 05 00 - 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 05 00.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01 77 00 operation and maintenance manuals for items included under this Section.

PART 2 PRODUCTS

2.01 GENERAL

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.

2.02 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.

2.03 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. 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:

a. 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.

b. Thermoplastic insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-61-402 (latest edition), NEMA Publication WC5.

c. 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.

d. 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.

e. Type "XHHW" heat resistant wire shall be used for wiring of recessed fixtures, and between fixtures and their adjacent outlets.

f. For 480 volt standard service, single conductor stranded copper cable shall have corona, ozone, heat and moisture resistant cross-linked polyethylene 600 volt insulation, rated to withstand a copper temperature of 90°C. without deterioration. It shall meet applicable ICEA Standards, and be UL labeled XHHW.

g. 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

h. 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.

i. 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, or Triangle.

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 degrees Celsius 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 degrees without deterioration. Insulation shall be a 20-mil wall of polyethylene with a 10-mil thick polyvinyl chloride jacket. 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 degrees 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 degrees Fahrenheit, 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. 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 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.

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 4X for outside use where exposed to the weather or where otherwise called for 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. Cast boxes shall meet the requirements for galvanized finish specified for steel conduits.
2. 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.

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. 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.
3. Switch and Receptacle Plates:
4. 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.
5. Cadmium plated steel plates shall be installed in equipment space and process areas.
6. Grouped devices shall be mounted in a single continuous gang plate.

M. 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 as listed on the Plans. 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. Fixtures, signs, etc., shall carry the approval of the Underwriters Laboratories, Inc., and be so labeled.

N. Lamps:

1. Contractor shall furnish and install all lamps for all types of lighting fixtures as shown on the schedules and drawings. Fixtures shall be cleaned, and all lamps shall be relamped at the end of the job.
2. Led lamp color temperature shall be, 4000 degrees K. The initial light output shall be 3,000 lumens.

O. 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.

P. Heat Trace System:

1. Heat trace cable shall be 120 VAC, 5 watts/ft., furnished with heat trace controller and ground-fault protection device (as required per the NEC). Heat trace cable shall be manufactured by Chromalox CPR series or equal. Heat trace controller shall be manufactured by Chromalox TPR series or equal.

Q. Telephone Box and Handset:

1. Telephone box shall be NEMA 4X, surface mount, with latching door. The telephone box and handset shall be manufactured by Hubbell/GAI-Tronics Model 354-001 or equal.

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).

2.04 MIXES

A. Patches, conduit sealing compound, fire stop compounds, etc., shall be mixed in accordance with the manufacturer's recommendations.

2.05 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.

PART 3 EXECUTION

3.01 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. 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.

C. Conduit Fittings:

1. Conduit fittings shall be made of a compatible material as the conduit. Conduit fittings with blank covers shall have rubber gaskets except in clean, dry areas and shall be accessible after the Work is completed.

D. 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.

E. Lighting:

1. Lighting fixtures shall be mounted level at the height as indicated on the Plans.

F. 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.

G. 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.

H. 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.

I. 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 Contractor's 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 with serve all and eliminate additional panels.

J. 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, or Penn-Union Electric Company.

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 knock-outs 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.

K. 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.

L. 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. Testing 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 ADJUSTING 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

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required to provide a complete grounding system for the electrical and instrumentation system as shown on the Drawings, specified or required, including:

1. Grounding electrodes and conductors.
2. Equipment grounding conductors.
3. Bonding.
4. Metal underground utility piping.
5. Metal frame of the building.
6. Ground loops, risers, and conductors.
7. Rod electrodes.
8. Ground mat.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 07 05 - Electrical Test Certificates

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code

1.04 SUBMITTALS

A. Shop Drawings:

1. Complete layout and location plans of the grounding electrode system and main grounding conductors.
2. Material schedule of components proposed for use.
3. Instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

B. Product Data: Manufacturer's Specifications, Technical Data, Dimensional Data, and installation instructions for components proposed for use under this Section.

C. Quality Assurance: Test Certificates

D. Project Record Documents: The following documentation shall be provided in accordance with Section 01 77 00 - Closeout Procedures:

1. Complete as-installed layout and location plans of the grounding electrode system and main grounding conductors.

1.05 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

B. In the event that the ground resistance is not 5 ohms or less, additional rods or longer rods shall be installed or the soil treated to reduce its resistance by approved practices. ground

resistance measurements shall be made using the fall-of-potential method only and test reports shall be provided as specified.

C. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 ROD ELECTRODES

A. Ground rods shall be 3/4-inch diameter by 10 feet long and shall have copper jackets and steel cores. Rods shall be as manufactured by Blackburn/Eritech, Erico Electrical Products, Harger, or equal.

2.02 MECHANICAL CONNECTORS

A. Compression connectors, lugs, etc., used in grounding circuits in any location shall have bolts, nuts, etc., of silicon bronze alloy equal to "Everdur" metal. Grounding connections, clamps, etc., shall be as manufactured by Burndy Engineering Company, Thomas and Betts Company, Delta-Star Electric Company, Harger, or equal.

B. Fittings for bonding a grounding conductor to metallic conduit shall be Thomas and Betts Series 3900BU or equal. Fittings for bonding a grounding conductor to its own conduit shall be Burndy Engineering Company GAR-BU Series, Thomas and Betts Series 3900, Harger, or equal.

C. Where connections to ground rods or ground mats must be disconnected for testing, the fittings shall be Burndy Engineering Co. Type GD, GG, GAR; Thomas and Betts Co. Series 3902BU; Harger; or equal.

2.03 EXOTHERMIC CONNECTIONS

A. Connections to steel, between conductors, and for water stops shall consist of exothermic welding similar and equal to Burndy Engineering Company's "Thermoweld", Erico Products, Inc. "Cadweld Kits", Thomas & Betts Corp. “Furseweld”, or Harger.

2.04 CONDUCTORS

A. Grounding conductors, loops, and risers shall be bare, stranded, soft-drawn copper and shall be of the sizes indicated on Drawings.

B. Bonding jumpers shall be copper and of a cross-sectional area at least equal to their corresponding grounding conductors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that final backfill, and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Rod electrodes shall be driven into undisturbed earth or engineered backfill only.

C. Provide bonding to meet Regulatory Requirements.

D. The non-current carrying parts of all electrical equipment installed under this Contract, including but not limited to raceways, raceway supports, and equipment enclosures, shall be bonded by means of bare copper cable or copper strap to the grounding system as shown on the Drawings and specified hereinafter.

E. Underground, metallic, service piping (water, gas, etc.) shall be solidly connected to the building grounding system with a No. 4/0 AWG grounding conductor (minimum) at the piping's entrance to the building.

F. Exposed, including painted or coated, structural and architectural metal shall be bonded to the grounding system or rigidly secured to and in good electrical contact with grounded metal.

G. Grounding cables, bus, etc., in locations where subject to mechanical damage, shall be protected by rigid metal conduit, steel guards, non-metallic conduit, or other suitable shield. Where conduit or other metallic encasement of grounding conductors is required, the conductor shall be permanently and effectively grounded to the enclosure at both ends of its length. This requirement applies to enclosures regardless of their length.

H. Where grounding conductors pass through floor slabs, building walls, etc., and are not encased in the concrete pour, sleeves of rigid metal conduit or non-metallic conduit of the required size, shape, and length shall be provided with both ends of the sleeve sealed with duct seal after installation of the grounding conductor.

I. Where grounding conductors pass through a concrete pour (encased), from underground to the interior of a structure, an exothermic water stop shall be provided on the grounding conductor within the pour.

J. 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.

K. Where a grounding cable is to be bonded to structural or architectural metal, the exact location of each bond shall be approved by Owner. The location of such grounding connections shall be at points where they will not be subject to mechanical damage and, if possible, shall be accessible for inspection.

L. Where welding to steel is prohibited, the grounding conductor shall be bolted directly to the steel as approved by Owner. The contact surfaces of bolted connections shall be thoroughly cleaned and coated with Alcoa No. 2 Electrical Joint Compound or equal.

M. Taps and splices in grounding cables and connections to ground rods shall be made by an exothermic weld process.

N. Metal ducts, conduits, starters, panels, switches, etc., which are not rigidly secured to and in good electrical contact with the grounded structural metal frame of the building or grounded conduit system, or which are subject to excessive vibration and loosened ground contacts, shall be securely bonded to grounded building steel or to the grounded conduit system by means of stranded copper jumpers. This jumper shall have a circular-mil cross section of not less than 50 percent of that of the largest conductor entering the enclosure being grounded, with a minimum size of No. 8 AWG stranded copper being used in any jumper.

O. 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. 8 AWG with solderless indent type lugs. Jumper shall be connected from a grounding type locknut or bushing on the conduit inside the box to a stud or silicon bronze alloy bolt in the cabinet frame.

P. Metal support racks for electrical equipment and enclosures shall be securely bonded to grounded building steel or the grounding system with a No. 2 AWG grounding conductor.

Q. A copper ground conductor shall be carried for each power, lighting at 120 volts and higher, and receptacle circuit with the circuit conductors. The ground conductor shall have the same type insulation as the circuit conductors and shall be green in color through No. 10 AWG and bare copper wire for larger sizes.

R. Switchgear, motor control center, distribution panelboard, and automatic transfer switch grounding shall consist of ground connections to feeder conduits, ground busses, etc. as required or as indicated on the Drawings.

S. Splices in wire or cable ground leads shall not be permitted.

3.03 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required to provide supporting systems for equipment, boxes, cabinets, consoles, panels, enclosures, conduit, cable tray, wireway, busway, and cablebus as shown on the Drawings, specified or required.

1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electric Code

1.03 SUBMITTALS

A. Shop Drawings:

1. Drawings, including capacity and loading calculations for support systems.
2. Detail dimensions.
3. Bills of Materials.

B. Product Data:

1. Copies of manufacturer’s specifications including material, dimensional and weight data and load capacity for each supporting system component proposed for use.
2. Pictorial views and corresponding identifying text of each component proposed for installation.

1.04 QUALITY ASSURANCE

A. Designs and drawings, including capacity and loading calculations for support systems shall be prepared a professional engineer registered in the State of Michigan.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Conduit and equipment supports and hangers shall be made of galvanized structural steel, with welded or bolted joints. Conduit and equipment supports and hangers shall be fabricated from "Unistrut" Series P1000 galvanized channels and fittings, as manufactured by the Unistrut Products Company, Superstrut A-1200 Series, Grinnell "Power-Strut" PS-200, or equal.

D. Conduit and equipment supports, hangers, beam clamps (no "C" clamps shall be allowed), and other similar devices made of steel shall be hot dipped galvanized or sherardized after fabrication. All hanger rods, U-bolts, bolts, nuts, and other threaded support components shall be electro-galvanized (per ASTM-B633 Type III SC1) or sherardized. Field cuts and all welds shall be coated with an approved cold or hot galvanizing compound: Z.R.C., CRC Chemicals Zinc-It, or equal. All hanger rods shall be 3/8-inch diameter, minimum. All such hardware shall be factory encased with polyvinyl chloride (PVC) of minimum 0.040-inch (40 mil) thickness where indicated on the Drawings and where specified elsewhere. All touch-up required in the field shall be in strict accordance with the manufacturer's printed instructions.

E. Concrete inserts shall be of the continuous channel or spot type. The channel type shall be No. 12 gauge steel with integral anchors, Super Strut No. C-302, Kindorf No. D-990, or equal. Spot inserts shall be Super Strut No. 452, Kindorf No. D-255, or equal.

F. Threaded anchors for use in concrete shall be self-drilling type expansion anchors made of case hardened and drawn carburized steel. The anchors and expander plugs shall be furnished with a rustproof finish. The expansion anchors shall be concrete fasteners as manufactured by the ITW "Red Head", Ideal Industries Co., or equal.

G. Threaded anchors for heavy loads (i.e.: panels, transformers, disconnect switches) supported from masonry or precast concrete panels shall be epoxy based adhesive anchors with threaded rod and screen tube. Adhesives shall match the application, as recommended by the anchor manufacturer. Threaded rods, nuts, and washers shall be furnished with a rustproof finish. Adhesive anchors shall be Hilti Type HIT or equal.

H. Anchors for light loads (i.e.: conduit clamps, outlet boxes, small pull and junction boxes) supported from masonry or precast concrete panels shall be lead type or plastic expansion anchors with corrosion resistant screws.

I. Threaded rods, nuts, washers, screws, and bolts for anchors used in areas classified as hazardous and in corrosive areas shall be made of 316 stainless steel. Also expansion anchors for light loads used in masonry or precast concrete panels in these areas shall be plastic only.

J. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID “A Special”, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions. Tighten all bolted connections to manufacturer’s recommended torque values with compensation for lubricated threads (anti-seize, lubricating and protective compound applied) to avoid over-torquing.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not anchor supports from pipes, ducts, mechanical equipment, or conduit.

D. Do not use spring steel clips and clamps.

E. Obtain permission from Engineer before using powder-actuated anchors.

F. Obtain permission from Engineer before drilling or cutting structural members.

G. Fabricate supports from structural steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Field Cutting: Cut edges of strut and hanger rod shall have corners rounded, edges beveled and burrs removed. If field cutting the strut is required, only clean, sharp, dedicated tools shall be used. Oil, shavings and other residue of cuttings shall be removed prior to installation.

I. Install surface-mounted cabinets and panelboards with minimum of four anchors.

J. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.

K. All electrical enclosures, including raceways, boxes, panelboards, motor control equipment, etc., shall be securely attached to the building or structure walls by means of concrete inserts or expansion anchors, unless indicated as rack mounted on the Drawings or of free standing design. Unless otherwise indicated, all electrical enclosures, except conduit and outlet boxes,

shall be spaced at least 1/2 inch from the wall or ceiling with Unistrut, Grinnell "Power-Strut", or equal.

L. The use of wood plugs for anchoring raceways, cabinets, enclosures, or equipment to concrete or masonry will not be permitted.

M. Contractor shall provide and install, where required, the additional steel to adequately support all conduits, boxes, and all other electrical equipment.

N. Wires and cables shall be laced when entering or leaving pull or junction boxes and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit. All wiring entering and exiting electrical enclosures shall be bundled into groups. Power, lighting, control, alarm, annunciator, and instrumentation wiring shall be bundled and laced as specified herein.

O. The threads of all corrosive area, hazardous area, outdoor, and below grade support connections shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

P. Metallic, except stainless steel, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum 0.040-inch (40 mil) thickness as specified under 26 05 33.23 - Surface Raceways for Electrical Systems. Where factory PVC coating is not available, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

END OF SECTION

SECTION 26 05 33.13
UNDERGROUND CONDUIT SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals to provide direct buried conduit as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 33.23 - Surface Raceways for Electrical Systems

1.03 REFERENCE STAND

A. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

E. ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality

F. IEEE C2 - National Electrical Safety Code

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit

I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

J. NEMA TC 6&8 - Polyvinyl Chloride (PVC) Plastic Utilities for Underground Installations

K. NEMA TC 9 - Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

L. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation

M. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series

N. NFPA 70 - National Electrical Code (NEC)

O. UL 6 - UL Standard for Safety Electrical Rigid Metal Conduit – Steel

1.04 SUBMITTALS

A. Shop Drawings:

1. Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes and handholes.

2. Indicate dimensions, reinforcement, size, and routings of underground ducts and duct banks.

B. Product Data:

1. Provide for metallic conduit; non-metallic duct, conduit, and duct fittings; manhole and handhole accessories, frames, and covers.

C. Manufacturer's Instructions:

1. Include instructions for storage, handling, protection, examination, preparation, and installation.

D. Project Record Documents:

1. Accurately record actual locations of each manhole and handhole.

1.05 REGULATORY REQUIREMENTS

A. Provide Products listed and classified by Underwriters Laboratories, Inc., or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00 - Product Requirements.

B. Accept conduit on site.

C. Inspect for damage.

D. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.07 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Contract Drawings.

B. Verify routing and termination locations of underground conduits prior to excavation for rough-in.

PART 2 PRODUCTS

2.01 RIGID ALUMINUM CONDUIT

A. Manufacturers: As specified under Section 26 05 33.23 - Surface Raceways for Electrical Systems.

B. Rigid Steel Conduit: ANSI C80.5, UL6.

C. Fittings: ANSI/NEMA FB 1; UL Standard 514B; steel.

2.02 NON-METALLIC CONDUIT

A. Manufacturers:

1. Carlon
2. JM Eagle
3. Osburn Associates, Inc.
4. Scepter
5. Cantex

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3. Fittings and adapters shall be as supplied by the conduit manufacturer.

2.03 NON-METALLIC, PVC DUCT

A. Manufacturers:

1. JM Eagle
2. Robintech
3. Osburn Associates, Inc.

B. Plastic Utilities Duct: NEMA TC 8; PVC, Type EB or DB.

C. Plastic Utility Duct Fittings: NEMA TC 9.

D. Plastic Communications Duct and Fittings: NEMA TC 10, Type EB or DB.

E. Fittings and adapters shall be as supplied by the duct manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavation, base material installation, and compaction is completed.

3.02 DIRECT BURIED CONDUIT INSTALLATION

A. Underground conduits for direct burial shall be rigid aluminum conduit or non-metallic conduit.

B. Install rigid steel conduit according to NECA 101-2006.

C. Plastic fittings shall be of the type recommended for the type of conduit used. Conduits shall be coupled together to make a water-tight connection.

D. Install non-metallic conduit in accordance with manufacturer's instructions.

E. Join non-metallic conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full, even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. Contractor shall allow 24 hours, minimum, for solvents to evaporate after cementing the last joint in the raceway system before pulling in any wires or cables.

F. Direct buried conduits shall be installed 30 inches (minimum) below grade (unless otherwise shown on Drawings) and shall slope (minimum 3 inches per 100 feet) to handholes, manholes, cable vaults, or other structures.

G. Changes in conduit elevation such as ells, stubs, bends, etc., shall be galvanized rigid steel. Conduit risers above grade shall be rigid steel. Conduits shall be rigid steel within 10'-0" of structures. Conduits under buildings shall be rigid steel.

H. Provide suitable fish line in each spare or empty duct, except sleeves and nipples.

I. Excavate and backfill trenches in accordance with other Sections of the Specifications, or in accordance with the Contract Drawings. Install warning tape above duct runs, as indicated on the Contract Drawings.

END OF SECTION

SECTION 26 05 33.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to provide wall and ceiling outlet boxes, pull and junctions boxes, and wireways as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 33.13 - Underground Conduit Systems

E. Section 26 05 33.23 - Surface Raceways for Electrical Systems

F. Section 26 05 53 - Electrical Identification

G. Section 26 27 16 - Cabinets and Enclosures

H. Section 26 27 26 - Wiring Devices

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

C. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

D. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

F. NFPA 70 - National Electrical Code

1.04 SUBMITTALS

A. Shop Drawings:

1. Indicate materials, finishes, dimensions, listings, and standards compliance.

B. Product Data:

1. Provide data for boxes, wireways, and accessories.

C. Manufacturer’s Instructions:

1. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

D. Project Record Documents: The following documentation shall be provided in accordance with Section 01 77 00 - Closeout Procedures:

1. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 REGULATORY REQUIREMENTS

A. Provide Products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.

B. Boxes shall be sized per Article 314 of the National Electrical Code as a minimum.

PART 2 PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.

2. Concrete Ceiling Boxes: Concrete type.

B. Non-metallic Outlet Boxes: NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

D. Wall Plates for Finished Areas: As specified in Section 26 27 16.

E. Covers for boxes containing wiring devices shall be as specified in Section 26 27 16.

F. Outlet boxes for pendant mounted lighting fixtures shall be ball mount, GS or AL Series as manufactured by Appleton Electric Co. or equal. Outlet boxes for pendant mounted fixtures in hazardous areas shall be similar, except explosion proof, Appleton Electric Co. EFHU or equal.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Hinged Enclosures: As specified in Section 26 2716

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.

2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. Pull and junction boxes for hazardous areas shall be cast iron alloy, explosion proof, Class I, Division 1, Group D as manufactured by Curlee, Appleton, or equal, except boxes for intrinsically safe circuits may be NEMA Type 4 or non-metallic NEMA Type 4X rated.

E. Single and two gang pull boxes and junction boxes shall be rust proof, cast metal, Type FD boxes with gasketed covers.

F. Larger boxes and raceways shall be NEMA Type 4X with stainless steel hardware in all other locations or where indicated on the Drawings, built of Code gauge steel, with angle iron supports and braces. Cable support racks shall be provided where required. Access shall be by means of removable, gasketed screw covers fastened with machine screws.

G. NEMA Type 4X boxes shall be of corrosion resistant, 304 stainless steel suitable for surface mounting. Barriers shall be provided where indicated on the Drawings or required.

H. All pull boxes installed below grade within the structures shall be provided with a drain, Crouse-Hinds ECD Universal Series, Appleton, or equal mounted on a bolt-on, gasketed hub or Stahlin Drain Vent on NEMA Type 4X boxes.

I. In-line pull boxes, where shown on the Drawings, shall be Appleton Type PTC with solid gasket or equal.

J. Threaded conduit fittings with gasketed covers shall be used for exposed conduit outlets and boxes.

K. Conduit bodies and fittings shall be of cast iron, malleable iron, and/or galvanized steel.

2.03 WIREWAYS

A. Wiring ducts shall be NEMA 4X in corrosive locations; or stainless steel, where indicated on the Drawings. Metallic wireways shall be 14-gauge steel raceways and all wireways shall be provided with removable covers held with captive screws. Fittings shall be designed to be used with the ducts to result in an unobstructed system. The ducts and fittings shall be sized as shown on the Drawings. Hardware on stainless steel and non-metallic wiring ducts shall be made of stainless steel.

B. The wiring ducts shall be as manufactured by Keystone, Hoffman Engineering Co., B-Line, or equal.

2.04 MISCELLANEOUS COMPONENTS

A. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID “A Special”, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify locations of floor boxes and outlets in all work areas prior to rough-in.

3.02 INSTALLATION

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install pull boxes and junction boxes in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Pull boxes and/or junction boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet after 90 degrees of bends, every 100 feet after 180 degrees of bends, and every 50 feet after 270 degrees of bends. More than 270 degrees worth of bends shall not be installed between pulling points in any conduit run.

D. Pull boxes, auxiliary pull fittings (slip joints), and cable raceways for the pulling, nesting, or concealment of wires or cables shall be provided where indicated on the Drawings and also where required, though not indicated, as specified above.

E. Mark or label all boxes as specified in 26 05 53 - Electrical Identification

F. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

G. Enough room shall be supplied in boxes for insulating joints, wires, and bushings, and deep boxes shall be installed where required by the type of fixture or outlet called for on the Drawings.

H. Wire and cable splices and tap connections shall be made in junction boxes only; condulet type fittings shall not be used as junction boxes.

I. Electrical boxes are shown on Drawings in approximate locations, unless dimensioned. Adjust box location up to 8 feet, if required to accommodate intended purpose.

J. Orient boxes to accommodate wiring devices oriented as specified in 26 27 16 - Cabinets and Enclosures.

K. Maintain headroom and present neat mechanical appearance.

L. Install boxes to preserve fire resistance rating of partitions and other elements.

M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

N. Use flush mounting outlet box in finished areas.

O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

P. At each concealed outlet in slabs or walls in dry locations only, a galvanized, pressed steel box of the knockout type, of not less than No. 12 B & S gauge, shall be placed and securely fastened. The conduits shall be fastened to these boxes with lock nuts, inside and outside, and bushings. Unused knockouts or holes must be left sealed.

Q. Support boxes independently of conduit.

R. Use gang box where more than one device is mounted together. Do not use sectional box.

S. Use cast outlet box in exterior locations and wet locations.

T. Set floor boxes level.

U. Wall and ceiling mounted pull and junction boxes shall be spaced 1/2-inch minimum out from the wall or ceiling using corrosion resistant channel: Unistrut; Grinnell “Power-Strut”, or other approved corrosion resistant spacers.

V. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

W. The threads of all corrosive area, hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, lighting fixture reflector, guard, and outlet box connections, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

X. Metallic, except stainless steel, pull boxes, junction boxes, outlet boxes, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum 0.040-inch (40 mil) thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

3.03 ADJUSTING AND CLEANING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

C. Clean interior of boxes to remove dust, debris, and other material.

D. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 33.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to provide the following items, as shown on the Drawings:

1. Metal conduit.
2. Flexible metal conduit.
3. Liquidtight flexible metal conduit.
4. Non-metallic conduit.
5. Flexible non-metallic conduit.
6. Fittings and conduit bodies.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 33.13 - Underground Conduit Systems

E. Section 26 05 33.16 - Boxes for Electrical Systems

F. Section 26 05 53 - Electrical Identification

G. Section 26 07 00 - Wire and Cable

H. Section 26 07 05 - Electrical Testing and Equipment

1.03 REFERENCE STANDARDS

A. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A)

B. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT)

C. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

E. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit

F. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit

G. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

H. NFPA 70 - National Electrical Code

I. UL 6 - Electrical Rigid Metal Conduit-Steel

1.04 SUBMITTALS

A. Shop Drawings:

1. Indicate materials, finishes, dimensions, listings, and standards compliance.

B. Product Data:

1. Provide data for boxes, wireways, and accessories.

C. Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

D. Project Record Documents: The following documentation shall be provided in accordance with Section 01 77 00 - Closeout Procedures:

1. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00 - Product Requirements.

B. Accept materials on site and inspect for damage.

C. Conduit shall be delivered at the construction site in not less than ten-foot lengths; each length of conduit to have approval label of the Underwriters.

D. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

E. Protect PVC conduit from sunlight.

1.06 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations, unless dimensioned. Route as required to complete the raceway system.

PART 2 PRODUCTS

2.01 CONDUIT AND FITTINGS

A. Provide conduit, conduit fittings, outlet boxes, pull boxes, supports, hangers, plates, and such other items as are incidental to or required for a complete installation, which shall be made of cast aluminum unless indicated otherwise.

B. No threadless couplings or running threads will be permitted on rigid conduits.

C. No conduit smaller than 3/4-inch shall be used, unless otherwise indicated or specified.

D. raceways shall be marked with the manufacturer's name or trademark as well as type of raceway and size. This marking shall appear at least once every 10 feet and shall be of sufficient durability to withstand the environment involved.

E. Wherever conduits cross building, tank, or other structural expansion joints, Contractor shall provide and install conduit expansion/deflection fittings as manufactured by O.Z./Gedney Type DX, Crouse-Hinds, Thomas & Betts, or equal, unless indicated on the Drawings as requiring an expansion fitting.

F. Expansion fittings with copper, ground bonding jumpers shall be installed where indicated on the Drawings and shall be O.Z./Gedney Type AX with Type BJ bonding jumper, Crouse-Hinds, or equal.

2.02 RIGID METAL CONDUIT

A. Rigid aluminum conduits shall be manufactured of 6063 alloy, temper T-1, and especially selected with reference to uniformity of thickness and free from defects.

B. Manufacturers:

1. V.A.W. of America, Inc.
2. Alcoa
3. Engineer-approved equal

C. Rigid Aluminum Conduit: ANSI C80.5, UL 6.

2.03 PVC COATED METAL CONDUIT AND FITTINGS

A. Manufacturers:

1. Thomas & Betts Ocal Blue
2. Robroy Industries Plasti-Bond Red H_2OT

B. Description: NEMA RN 1; rigid aluminum conduit with external PVC coating, 40-mil thick. UL listed with the PVC coating as the primary corrosion protection.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; aluminum fittings with external PVC coating to match conduit. UL listed with the PVC coating as the primary corrosion protection.

D. PVC coated conduit, fittings, and fasteners shall be supplied from the same manufacturer.

E. PVC coated conduit shall be rigid metal conduit factory encased with polyvinyl chloride of 0.040-inch (40 mil) thickness minimum on the exterior and a urethane coating of 0.002-inch (2 mil) thickness nominal or a phenolic coating of 0.003-inch (3 mil) thickness nominal on the interior. The adhesion of the coating shall be greater than the tensile strength of the coating (NEMA RN1 requires a minimum tensile strength of 2000 psi for PVC).

F. Fittings and fasteners shall have the same PVC coating on the exterior as the conduit. Hollow fittings shall also have the same interior coating as the conduit. Couplings, fittings, and conduit bodies shall have PVC sleeves at threaded joints with length equal to the outside diameter of the associated conduit or 2 inches. Conduit body covers shall be provided with stainless steel screws with PVC coated, hex heads.

2.04 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC
2. Southwire - Alflex

B. Description: Interlocked aluminum construction.

C. Fittings: ANSI/NEMA FB 1.

D. Flexible metallic conduit shall be 3/4-inch nominal trade size (minimum) flexible aluminum conduit tubing, meeting Underwriters' Laboratories Standard for flexible steel conduit (UL 1).

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Anaconda
2. Electriflex
3. AFC
4. Thomas & Betts Corp.

B. Description: Interlocked aluminum construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1.

D. Fittings used with this conduit shall be of the liquid tight type and shall be equipped with approved type grounding devices to ensure continuity between the conduit and the connection. The fittings shall seal out vapors, coolants, oil, water, dust, and other foreign matter and shall be installed with a sealing O-ring between the fitting and the box. The fittings shall be “ST” series connections as manufactured by Appleton Electric Co., Ideal Industries 75-000 Series, or equal.

2.06 NON-METALLIC, PVC CONDUIT

A. Manufacturers:

1. Thomas & Betts – Carlon
2. JM Eagle
3. Osburn Associates, Inc.
4. IPEX - Scepter
5. Cantex

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

D. Plastic (PVC) conduit shall be heavy wall, Schedule 40 with integral bell, polyvinyl chloride (PVC), non-metallic conduit.

2.07 RIGID STEEL CONDUIT

A. Rigid steel conduits shall consist of heavy wall, mild steel tube, hot-dipped galvanized with threads electrogalvanized after cutting, and especially selected with reference to uniformity of thickness and freedom from defects. Fittings shall be suitable and approved for use in rigid steel conduit systems.

B. Rigid galvanized conduit shall be used if conduit is installed in concrete floor or walls.

C. Manufacturers:

1. Wheatland Tube Company
2. Allied Tube & Conduit Corporation
3. Maverick Pipe
4. Approved Equal

D. Rigid Steel Conduit: ANSI C80.1, UL 6.

E. Fittings and Conduit Bodies: ANSI/NEMA FB 1; UL 514B; all steel fittings.

2.08 MISCELLANEOUS FITTINGS AND MATERIALS

A. Insulated grounding bushings shall be Type HBLG as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.

B. Insulating bushings shall be high impact resistant, thermoset plastic, 150°C rated, Type A as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.

C. Locknuts shall be of the sealing type, O.Z./Gedney Type SLG, Appleton, American Fittings Corp., Thomas & Betts, or equal.

D. Liquidtight hubs shall have a sealing ring between the fitting and the box and an insulated throat to ensure protection of the wires as pulled. Hubs shall be made of aluminum, UL listed, and shall meet or exceed the requirements of UL test 514B. Liquidtight hubs shall be Bridgeport, O.Z./Gedney Type CHM, Ideal Industries 75-000 Series, American Fittings Corp., Thomas & Betts, or equal.

E. Sealing fittings shall be Crouse-Hinds Co. Type EYS, Appleton, or equal. Sealing fittings used as water stops shall have an integral drain and shall be Crouse-Hinds Type EYD, Appleton, Thomas & Betts, or equal. Sealing fittings in hazardous or corrosive areas shall be PVC coated.

F. Conduit sealing compound shall be Waterguard Desiccants Industrial Encapsulant, Polywater FST-250, or equal.

G. Link seal for sealing conduits into sleeves and cored openings shall be GPT Industries - Thunderline, Metraflex Co. Metraseal, Calpico, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install conduit in accordance with NECA 101-2013, Aluminum Conduits (Rigid, IMC, EMT).

B. Arrange supports to prevent misalignment during wiring installation.

C. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

D. Do not attach conduit to ceiling support wires.

E. Arrange conduit to maintain headroom and present neat appearance.

F. Identify raceway systems under provisions of Section 26 05 53 - Electrical Identification.

G. Joints shall be made tight with standard couplings and corners turned with elbows or long radius bends in pipe.

H. Exposed multiple runs of conduit indoors shall be supported on hangers suspended from concrete inserts or structural steel. Single runs of conduit may be attached to ceilings or walls by means of approved type anchors. Conduit and other equipment may be attached to structural steel only where approved by Owner. Conduit shall be secured to the supports by means of galvanized malleable iron clamps using two bolts or machine screws. Conduit supports, hangers, and anchors shall be as specified under Section 26 05 29 - Hangers and Supports for Electrical Systems.

I. The use of wood plugs for anchoring raceways to concrete or masonry will not be permitted.

J. Conduits installed exposed shall be run vertically or horizontally and shall be parallel or at right angles to the building or structure walls.

K. Contractor shall provide and install, where required, the additional steel to adequately support conduits, boxes, and other electrical equipment.

L. Conduit shall be dry, clean, and free of obstructions before conductors are pulled in. If there is evidence of moisture, obstructions, or foreign matter in the conduit when the conductors are installed, the wiring shall be removed, and the conduit cleaned to the satisfaction of Owner. Wiring showing evidence of damaged insulation shall be replaced.

M. Concealed conduit shall be placed in floors, ceilings, and walls before concrete is poured and in masonry walls as the walls are laid up. The conduit shall be blocked and fastened in place to prevent any displacement during construction. Conduits shall be separated by at least one conduit diameter, unless specifically authorized by Owner to do otherwise. Conduit joints shall be made tight with galvanized couplings or approved unions.

N. Steel conduit run exposed shall be supported at intervals not exceeding 8 feet, unless shown otherwise on the Drawings. Multiple runs of conduit shall be mounted with steel supports so arranged that each individual conduit is clamped in place.

O. Conduit installed on walls shall be mounted on spacers to provide not less than 1/4-inch space between the conduit and the wall.

P. Conduit installed exposed outdoors shall be supported by structural steel members.

Q. Conduit entrances through below grade walls and poured-in-place concrete roofs shall be installed through sleeves poured in place or through core drilled opening, unless poured in place.

R. Sleeves for passage of conduits through poured concrete roofs and below grade walls shall be constructed of heavy wall steel pipe with full circle continuously welded water stop plate. Sleeves shall be sized to accommodate the conduit and link seal combination as specified hereinbefore.

S. Conduits passing through openings or sleeves in roofs, below grade walls, or floors shall be sealed in place and made watertight with link seal.

T. Conduit stubs for future use shall be terminated with pipe caps.

U. Conduit runs installed horizontally overhead shall allow a minimum of 7 feet of headroom, except where installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.

V. Wherever a conduit emerges from the underside of a slab or roof or enters an area from above and that slab or area or conduit is exposed to the weather, then that conduit shall be provided with a pull box or fitting and filled to a length of 12 inches minimum with conduit sealing compound where the conduit emerges indoors to prevent water from following the conduit interior. The sealing compound shall be as specified hereinbefore under Miscellaneous Fittings and Materials.

W. Wherever a conduit enters an electrical equipment enclosure from an underground or outdoor location and other locations where indicated on the Drawings, the conduit opening shall be sealed after the wires and/or cables are pulled. One and one half (1½) inch and smaller conduits with more than 20 percent wire fill may be sealed with conduit sealing compound; other conduits, where required, shall be provided with conduit sealing bushings or compound bushings with ground conductor connectors, as manufactured by O.Z./Gedney or equal. Conduit sealing compound shall be forced into conduits to a minimum depth of 12 inches.

X. Field bends in conduit shall not be of a lesser radius than that of manufactured elbows of the same trade size and shall show no flattening of the conduit. Conduit bends shall be held to as large a radius as possible for ease in pulling of conductors and to provide a neatly installed appearance. Generally, conduits 1-inch and smaller shall be bent in the field.

Y. Other conduit bends shall conform to the following: 2-inch and 2-1/2-inch conduit, 24-inch radius, 3-inch and larger with a minimum radius of 36 inches. Except where conduit runs are shown in exact detail on Drawings, the maximum length of straight conduit runs shall be 200 feet between pull boxes, with 50 feet deducted for each 90-degree bend and 25 feet deducted for each 45 degree bend, reduction in length for other angle bends shall be figured on a similar basis.

Z. Conduit parallel to or crossing uninsulated hot water or steam pipes shall be separated from same by 12 inches, if parallel, or 7 inches if crossing. Where hot water or steam pipe lines are insulated, conduit shall clear the insulation surface by 2 inches. Conduit shall not run directly under cold water lines.

AA. Conduit stub-ups into the bottom of NEMA Type 12, floor mounted enclosures, including motor control centers, shall enter the enclosure through individual holes in the bottom plate or sheet steel bottom and the openings shall be sealed around each conduit to maintain the enclosure's NEMA Type 12 rating.

BB. Conduits and sleeves passing through openings in walls above grade or floors shall be sealed in place and made watertight with non-shrink grout or other Owner approved sealant. Non-shrink grout used in floor or wall openings, shall be of the non-metallic type. Openings in fire rated walls and floors shall also be sealed with a fire barrier sealing system capable of maintaining the designed fire rating of the wall or floor and suitable for sealing out smoke and

fumes. The fire barrier sealing system shall be capable of passing the ASTM E-814 (UL 1479) fire test and shall be subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory; provide products by Hilti Construction Chemicals, Inc.; 3Mä Fire Protection Products; or equal.

CC. Openings in boxouts through floors or walls or in the bottom of electrical equipment shall be closed using split insulating blocks or non-shrink grout in a manner as approved by OWNER. Unused sleeves shall be capped or plugged at both ends with approved fittings.

DD. Metallic sleeves containing a ground conductor shall be bonded at each end to the ground conductor.

EE. The ends of metallic conduits or elbows shall be cut square, reamed and threaded.

FF. The threads of steel conduit connections concealed in concrete shall be coated at the time of installation with No. B69A45 Zinc clad primary coating, as manufactured by Sherwin William's Corp., Ideal Industries No. 40-630, CRC Chemicals Zinc-It, or equal.

GG. The threads (metallic) of corrosive area, outdoor, below grade, and hazardous area equipment connections including conduit, conduit fittings, pull and junction box covers, lighting fixture reflector, guard, and outlet box connections, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly. Coating compound shall be NO-OX-ID "A Special" by Sanchem, Inc., Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, or equal.

HH. Ground and bond metallic raceway systems under provisions of Section 26 0526, Grounding and Bonding.

II. Metallic conduits, except those terminated in metal boxes or enclosures without knockouts and secured with double locknuts, integral hubs, or liquid-tight hubs, shall be terminated with insulated grounding bushings. Conduits terminated in metal boxes or enclosures without knockouts and secured with double locknuts shall be terminated with an insulating bushing.

JJ. Conduits and sleeves, metallic and non-metallic, intended for the passage of wire or cable and not terminated with a fitting, shall be terminated with a bushing or end bell.

KK. Connections between metallic conduits and NEMA Type 1 or NEMA Type 12 steel boxes shall be made with double locknuts. Connections between conduits and NEMA Type 3, 3R, 4, and 4X boxes shall be made with watertight connections. Watertight connections shall consist of integral hubs or liquid-tight hubs.

LL. Sealing fittings and other fittings for conduit in hazardous locations shall be explosion proof, Class I, Division 1, Group D.

MM. Electrical metal tubing or so called "Thin Wall" conduit and fittings shall not be used.

NN. Raceway systems, in general, shall consist of Rigid Metal Conduit and fittings or non-metallic, FRP Conduit and fittings.

OO. Conduit and fittings in areas classified as corrosive, hazardous, and other areas indicated on the Drawings, shall be PVC coated metal conduit and fittings, unless constructed of stainless steel. The installation of such conduit and fittings shall be in strict accordance with the manufacturer's printed instructions and using the manufacturer's recommended tools and touch-up procedures.

PP. To guarantee proper installation procedures and ensure the validation of the manufacturer's warranty, Contractor must request installation training from the manufacturer, or manufacturer's appointed representative, prior to installing PVC coated conduit and fittings on the project.

1. The manufacturer shall provide installation training at no cost to Contractor.

2. Contractor shall provide the time and place, preferably at the job site, and the manufacturer shall certify every Contractor's employee completing the installation training.

QQ. Metallic conduit, conduit fittings, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum 0.040-inch (40 mil) thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

RR. Flexible conduit may be used only where rigid conduit is impracticable or where indicated on the Drawings.

SS. Liquid-tight, PVC coated, flexible metal conduit and associated fittings shall be installed as follows:

1. Sections of flexible conduit larger than 1-1/4 inches in diameter shall be paralleled with a braided copper bonding strap connected between the last section of rigid conduit and the frame of the equipment to ensure a continuous ground.

2. Liquid-tight, PVC coated, flexible metal conduit shall be installed with watertight connectors and in minimum lengths without sharp bends.

TT. Final conduit connections to motors and other machinery, equipment, and devices which may be subject to movement or vibration shall be made with 15 to 18 inches of flexible, liquid-tight, metallic conduit.

UU. Final conduit connections to motors and other machinery, equipment and devices in hazardous areas which may be subject to movement or vibration shall be made with explosion proof, Class I, Division 1, Group D, flexible conduit couplings.

VV. Flexible metallic conduit may be used for final connections to lay-in fluorescent lighting fixtures.

WW. Plastic (PVC) conduit may be used only where indicated on the Drawings.

XX. Install non-metallic conduit in accordance with manufacturer's instructions.

YY. Join non-metallic, PVC conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. Contractor shall allow 24 hours, minimum, for solvents to evaporate after cementing the last joint in the raceway system before pulling in any wires or cables.

END OF SECTION

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide nameplates and labels, wire and cable markers, conduit markers and other identification for all electrical apparatus as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 96 00 - Painting

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electric Code (NEC)

1.04 SUBMITTALS

A. Shop Drawings: The complete description and enumeration of proposed electrical-identification-nomenclature text and electrical-identification devices shall be shown on the Shop Drawings for the associated equipment or systems.

B. Product Data: Manufacturer’s cut sheets, specifications, dimensions and technical data for all products proposed to be furnished under this Section.

C. Samples:

1. Nameplates: Samples of nameplates shall be submitted for the Engineer’s selection of size and lettering style.

2. Wire Labels: Samples of wire and cable labels shall be submitted and shall include both applied and unapplied wire and cable label samples. These samples shall be used as quality standards for the wire and cable labeling required by this Section. These samples shall be of material specified in this Section and shall include wire and cable designators meeting the requirements of this Section.

D. Commissioning Documents: Point-to-point wiring diagrams annotated with wire numbers and terminal numbers shall be submitted prior to commissioning of associated equipment or systems.

PART 2 PRODUCTS

2.01 NAMEPLATES AND LABELS

A. The nameplates shall be 1-1/4-inch high by 3-1/2-inch wide (minimum), except pushbutton and selector switch stations and other enclosures where space is limited may have smaller plates of suitable size and shall be attached to the equipment by means of corrosion resistant screws. Nameplates may be attached to equipment located in dry, interior areas by means of pressure sensitive, firm acrylic adhesive tape, 3M "Scotch" No. 468 or equal. The plates shall be white laminated plastic with engraved black letters approximately 3/32-inch thick with beveled edges. Engraved letters shall be 1/8-inch high (minimum), block type.

B. Circuit number markers shall consist of self-adhesive vinyl cloth or polyvinyl fluoride film markers with 1/8-inch high (minimum), black lettering on a yellow background, W. H. Brady Co. 3410 Series, Ideal Industries 44-500 Series and 44-600 Series, or equal. Circuit number markers may also consist of computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, BradyMarker XC Plus, 3M Scotchcode SCS or STS, or equal. Circuit number markers for panelboard circuit breakers may be the manufacturer's standard.

C. Arc flash and shock hazard warning labels shall consist of self-adhesive vinyl or polyester signs, 3-1/2" by 5" minimum, with "!WARNING" header (black letters on orange field), "Arc Flash and Shock Hazard" subheader and write-in spaces for the following information:

1. ____ Flash Hazard Boundary
2. ____ cal/cm2 Flash Hazard at 18 inches
3. ____ PPE _____
4. ____ Shock Hazard When Cover is _____
5. ____ Limited Approach
6. ____ Restricted Approach _____
7. Equipment Name: _____

D. Warning labels shall be in compliance with NEC 110.16 requirements. Warning labels shall be Brady Signmark No. 89220, Lab Safety Supply Co. No. 68691, Seton Style No. M0548, or equal.

2.02 WIRE MARKERS

A. Wire and cable tags for use in large pull boxes, large junction boxes shall be made of 1/8-inch (minimum) thick white laminated plastic, 1-1/4-inches by 3-1/2-inches, with black engraved identification in letters 3/64-inch deep by 3/16-inch high (minimum). Tags shall be drilled at each end and secured twice to each cable by 3/32-inch (minimum) diameter polyethylene cord. Tags shall be engraved with the circuit number, equipment served, and associated nominal voltage level.

B. Wire and cable number tags for use in pull or junction boxes and at termination points shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, Brady Marker XC Plus, or 3M Scotchcode. Pre-printed, vinyl cloth, plastic coated, self-adhesive, tape markers as manufactured by W. H. Brady Co. or 3M Company shall also be acceptable.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive nameplates and labels.

3.02 INSTALLATION

A. Nameplates shall be installed on the doors or covers of all panels, panelboards, starters, contactors, transfer switches, relays, control devices, signaling devices, and all other electrical equipment furnished under this Contract, except remote mounted pushbutton and selector switch stations, mounted adjacent to identified and associated disconnect switches or other control devices, need not be identified as described herein.

B. Nameplate engraving for equipment and devices associated with motor control center, motor starters, panelboard, or control panel circuits shall match the engraving indicated in schedules on the Drawings, except nameplates for spare units and devices shall be furnished blank. Other nameplates shall be engraved as follows and shall be included on nameplate schedules submitted to the Owner for approval:

1. First Line: Process description, equipment served, or area served (if applicable).
2. Second Line: Equipment or device description.
3. Third Line: Equipment or device designation number and power source circuit number.
4. Abbreviations shall be used only where full wording will not fit. See the Drawings for nameplate details.

C. Devices and equipment powered from lighting panelboards shall be marked with the appropriate circuit number(s). Lighting circuits shall be identified on switch cover plates, receptacles on cover plates, and other devices on enclosure door or on associated disconnect switch door or cover.

D. The entire raceway system for intrinsically safe circuits shall be labeled "Intrinsic Safety Wiring" per National Electrical Code Article 504.80(B).

E. Pull boxes shall be marked with the type of system within them, i.e.: 480V power, alarm, 120V control, etc.

F. Wires and cables within control panels, motor starters, motor control centers, terminal boxes, etc. shall be tagged at each termination.

G. The wires and cables of each circuit in pull boxes and junction boxes larger than 12 inches by 12 inches by 8 inches shall be bundled together, neatly arranged, and clearly identified with a tag secured with polyethylene cabling twine indicating circuit number, equipment served, and nominal voltage level.

H. A system shall be developed and submitted to prevent duplication of wire numbers for wiring external to equipment. Equipment numbers or designations may be used as prefixes. Interconnecting diagrams shall clearly show wire numbers, originating terminal numbers, and destination terminal numbers.

I. Enclosures, panels, boxes, and devices containing electrical components and circuits with exposed, energized parts when the door is open, shall have an arc flash and shock hazard warning label affixed to the door. Label blank fields shall be filled in with permanent markers according to the results of the Short Circuit, Flash Hazard, and Protective Devices Coordination Analyses, in Section 26 07 05 - Electrical Testing and Equipment.

J. Label or otherwise clearly identify all panelboard branch circuit breakers feeding emergency lighting and exit fixtures as required by National Electrical Code Article 700.12(E).

END OF SECTION

SECTION 26 07 00
WIRE AND CABLE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide the following as shown on the Drawings, specified or required:

1. Building wire.
2. Underground feeder and branch circuit wire
3. VFD load wire
4. Instrumentation cable
5. Communications cables
6. Wiring connectors and connections

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 29 - Hangers and Supports for Electrical Systems

C. Section 26 05 33.13 - Underground Conduit Systems

D. Section 26 05 33.16 - Boxes for Electrical Systems

E. Section 26 05 33.23 - Surface Raceways for Electrical Systems

F. Section 26 05 53 - Electrical Identification

1.03 REFERENCE STANDARDS

A. ANSI C33.80 - Standard for Safety Grounding & Bonding Equipment

B. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation)

C. NFPA 70 - National Electric Code (NEC)

D. UL 44 - Thermoset-Insulated Wires and Cables

E. UL 83 - Thermoplastic-Insulated Wires and Cables

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data: Manufacturer’s cut sheets, specifications, dimensions and technical data for all products proposed to be furnished under this Section.

C. Test Reports: Indicate procedures and values obtained.

D. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

1.05 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Contract Drawings.

B. Wire and cable routing shown on Drawings is approximate. Route wire and cable as required to meet Project Conditions.

C. Where wire and cable routing are not shown, and destination only is indicated, determine exact routing and lengths required.

1.06 COORDINATION

A. Determine required separation between cable and other work.

B. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.01 GENERAL

A. Wires and cables shall be permanently identified, at intervals not exceeding 3 feet, indicating type, size, voltage rating, and manufacturer's name.

B. Wires and cables shall be continuous and shall be delivered in reels or in coils. Reels and coils shall be plainly marked for complete identification, including the wire or cable size, the number of conductors, the type of wire or cable, length, weight, thickness and character of the insulation, and the name of the manufacturer.

C. Coils and reels of wires or cables shall carry original date perforated inspection labels of the Underwriter's laboratories, Inc. showing the number of feet and type of wire contained.

2.02 BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor: Annealed, uncoated copper. Conductors shall be stranded. ASTM designation B-3.

C. Conductor Temperature Rating: 90 degrees Celsius in wet locations; 90 degrees Celsius in dry locations.

D. Insulation Voltage Rating: 600 volts.

E. Insulation: ANSI/NFPA 70, Type THWN; high temperature polyvinyl chloride with nylon jacket or Type XHHW-2, high temperature cross-linked polyethylene.

F. Manufacturers:

1. General Cable
2. Southwire Corporation

2.03 UNDERGROUND FEEDER AND BRANCH-CIRCUIT WIRE

A. Description: Single conductor, ANSI/NFPA 70, Type USE-2.

B. Conductor: Annealed copper. Conductors shall be stranded. ASTM designation B-3.

C. Conductor temperature rating: 90 degrees Celsius in wet locations; 90 degrees Celsius in dry locations.

D. Insulation voltage rating: 600 volts.

E. Insulation: Type RHW-2.

F. Manufacturers:

1. General Cable
2. Southwire Corporation

2.04 VFD LOAD WIRE

A. Description: Multi-conductor, ANSI/NFPA 70 Type XHHW-2 or Type RHW-2.

B. Conductor: Annealed copper. All conductors shall be stranded. ASTM designation B-8, B-33, B-172 or B-174.

C. Conductor temperature rating: 90oC in wet or dry locations; 130oC emergency overload rating.

D. Insulation voltage rating: 2000 volts minimum.

E. Insulation: Type XHHW-2 or Type RHW-2, Cross-linked Polyethylene (XLPE).

F. Shield: Overall copper tape shield with suitable overlap to prevent separation during installation.

G. Jacket: Sunlight resistant, black overall PVC in accordance with S-95-658/NEMA WC70.

H. Installation: If unshielded cable is provided, input line reactors must be provided and installed in VFD.

I. Manufacturers:

1. Southwire Corp.
2. Belden
3. General Cable
4. Okonite Okoguard-Okolon
5. Prysmian Cables & Systems

2.05 INSTRUMENTATION CABLE

A. Description:

1. Single pair cable shall be a single twisted pair, No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.
2. Multiple pair cable shall be two or more individual twisted pair, No. 18 gauge, stranded conductors, each pair with shield and drain wire, and an overall jacket.
3. Three conductor cable shall be three No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.

B. Underground and General Use Cables:

1. Conductors: Tinned copper.
2. Insulation voltage rating: 300 volts.
3. Insulation material:
    a. Single pair cable – polyethylene.
4. Multiple pair cable – polyethylene or polypropylene.
    a. Three conductor cable – polyethylene.
5. Shield Material: 100 percent aluminum polyester.
6. Drain Wire: Stranded, tinned copper.
7. Jacket: Chrome vinyl (PVC).
8. Riser and Plenum Use Cables: These cables shall be similar to the underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF

C. Manufacturers:

1. Single Pair Cable:
    a. Belden No. 8760
    b. Southwire Corporation
    c. General Cable/Carol Brand No. C2534
2. Multiple Pair Cable:
    a. Belden No. 9773 through No. 9777

b. Southwire Corporation

c. General Cable/Carol Brand No. C6047-C6051

3. Three Conductor Cable:

a. Belden No. 8770.

b. Southwire Corporation

c. General Cable/Carol Brand No. C2535

2.06 COMMUNICATIONS CABLE

A. Wire type communications cables shall meet all applicable standards of EIA/TIA, IEEE, and the NEC.

B. Fiberoptic cable shall meet applicable standards of EIA/TIA-4292.AAAA-1989, IEEE, and the NEC.

C. Riser and Plenum Use Cables: Cables shall be similar to underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF.

D. Manufacturers:

1. RS-232/422, RS-485/DH-485, Ethernet (Category 5), DH+ (Twinaxial), Unshielded twisted pair (UTP), and telephone cables shall be as manufactured by: Belden; Alpha; or Manhattan.

2. Fiber optic Cables shall be 62.5/125 micron, multi-mode, tight-buffered, breakout type rated for indoor/outdoor use, shall be as manufactured by Optical Cable Corp. Ultra-Fox B-Series, Siecor, or AT&T.

2.07 WIRING CONNECTORS AND ASSOCIATED MATERIALS

A. Wiring connectors shall be 75 degrees Celsius rated and suitable for use on copper conductors.

B. VFD Cable Fittings:

1. Fittings for terminating at VFDs shall conform to NEMA Standards.

2. VFD fittings shall be designed to provide termination of armor and shield, if provided.

3. When installed, VFD fittings shall include set-screws to limit vibrational loosening.

4. VFD fittings shall be suitable protected from corrosion and shall be UL listed for use in Type 3R enclosures.

5. Fittings shall form a water-tight seal to the outer jacket of the cable.

C. Cable or cord strain reliefs shall consist of stainless steel wire mesh with support bale. Strain reliefs shall be of the split rod type where required or indicated on the Drawings.

D. Cable Pulling Lubricant:

1. Lubricant shall be UL listed and approved for use on the cable jacket or insulation.

2. Lubricant shall be polymer based and shall dry completely when exposed to air.

E. Manufacturers:

1. Solderless Pressure Connectors:

a. 3M Company Model Scotchlok

b. Thomas & Betts Model Sta-Kon

c. Burndy Model Insulug Type TN

2. Spring Wire Connectors:
    a. 3M Company Model Scotchlok
    b. Ideal Model Wing-Nut
3. Compression Connectors:
    a. 3M Company Model Scotchlok
    b. Thomas & Betts Model Color-Keyed
    c. Burndy Model Hylug
4. Tap Connectors:
    a. Thomas & Betts Model Color-Keyed
    b. Burndy Model Crimpit
    c. Anderson Model Crimptaps
5. Watertight, Twist-On Connectors:
    a. 3M Company Direct Bury Splice Kits
    b. King Innovation “DryConn”
    c. Ideal Industries, Inc. Twister DB Plus
6. Watertight, Insulated Connector Blocks:
    a. Utilco Type USPA-SS, Type PSA-SS, or Type PED-SS
    b. Ilsco Type USPA-SS
7. Electrical Insulating Tape:
    a. 3M Company “Scotch” No. 33+
    b. Plymouth “Premium Black”
8. High Temperature Tape:
    a. 3M Company “Scotch” No. 70
    b. Plymouth “Plysil”
9. Fireproofing Tape:
    a. 3M Company “Scotch” No. 77
    b. Plymouth No. 50
10. Woven Fiberglass Tape:
    a. 3M Company “Scotch” No. 69
    b. Plymouth “Plyglas”
11. Color Coding Tape:
    a. 3M Company “Scotch” No. 35
    b. Plymouth “Slipknot” No. 45
12. Insulating and Watertight Sealing Materials:
    a. 3M Company “Scotchcast” kits
    b. Raychem WCS Series heat shrinkable sleeves
    c. 3M Company 8400 Series cold shrink materials

d. 3M Company “Scotchkote” sealant

13. Watertight Cord Grip Fittings:
    a. Crouse-Hinds CGB-SG Series
    b. Appleton Electric Co.
    c. Thomas & Betts
14. Cable or Cord Strain Relief:
    a. Hubbell-Kellems
    b. Daniel Woodhead Co.
15. Cable Pulling Lubricant:
    a. American Polywater “Dyna-Blue”
    b. Ideal “Aqua Gel”
    c. Minerallac “Golden Glide”
    d. 3M Company “GEL”

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 WIRING METHODS

A. Interior Locations:

1. Wire for general power, light, and control shall be building wire, Type THWN or Type XHHW-2 insulation, in raceway or metal sheathed or metal clad cable, where indicated.
2. Cables for instrumentation signals shall be single or multiple pair Instrumentation Cable.
3. Wire for connections between Variable Frequency Controllers and associated motors shall be shielded and shall be VFD Load Wire.

B. Exterior Locations:

1. Wire and cable for general power, light, and control for use in raceways exterior to buildings and in underground raceways shall be Type XHHW-2 insulation, underground feeder and branch circuit wire.
2. Cables for instrumentation signals shall be three or more pair Instrumentation Cable.
3. Wire for connections between Variable Frequency Controllers and associated motors shall be shielded and shall be VFD Load Wire.

C. Use wiring methods indicated on Drawings.

D. Color Coding: The color schedule for the conductor insulation of wire and cable shall conform to the following:

1. Three phase lighting and power, 208Y/120 VAC-Black, Red, Dark Blue, White or Gray, and Green ground.
2. Three phase lighting and power, 120/240 VAC-Black, Red, Orange (high leg to ground), White or Gray, and Green ground.

3. Single phase lighting and power, 120/240 VAC-Black, Red, White or Gray, and Green ground.
4. Three phase lighting and power, 480 VAC-Brown, Orange, Yellow, and Green ground.
5. Three phase lighting and power, 480Y/277 VAC-Brown, Orange, Yellow, Gray, and Green ground.
6. DC power – Red with White stripe (+) and Light Blue with White stripe (-).
7. Single conductor control, AC voltage – Red.
8. Multi-conductor control cables – ICEA Method 1.
9. Alarm, annunciator, instrumentation, graphic, and telemetering (if not shielded), AC voltage – Pink.
10. Alarm, annunciator, instrumentation, graphic, and telemetering (if not shielded), DC voltage – Light Blue.
11. Intrinsically safe circuits – Purple.
12. On wire sizes larger than Number 8 AWG and/or where authorized by the Owner, coding may be identified by taping with the appropriate colored self-adhesive vinyl color coding tape.
13. Grounding conductors shall be continuous green or bare for systems.
14. Neutral conductors shall be continuous white or gray for systems.

E. The installation of intrinsically safe circuits shall meet requirements of the NEC.

F. Wiring Connections:

1. Dry location splices and tap connections shall consist of compression connectors or tap connectors, taped to 150 percent of insulation rating of the conductors.
2. Final connections to equipment wire leads for No. 8 AWG and smaller wire in dry locations only, except 480 volt motor leads, may be made with spring wire connectors.
3. Wet and damp location splices and tap connections shall consist of compression connectors or tap connectors with insulating and watertight sealing materials; watertight, twist-on connectors for wire sizes up to three No. 10 AWG; or watertight, insulated connector blocks; providing watertight connections suitable for direct burial.
4. Conductor terminations at screw terminals shall consist of solderless pressure connectors, except where conductor terminations are included with the equipment being connected.
5. Insulation of connections in lighting fixture and high temperature equipment shall consist of silicone rubber type high temperature tape with a woven fiberglass tape over-wrap.
6. Electrical insulating tape (plastic type) shall be used on splice and tap connections, unless wire manufacturer’s recommendations require otherwise.

3.04 INSTALLATION

A. Installation of communication cables shall meet the requirements of NECA/BICSI 568-2001, Telecommunications.

B. Installation of fiber optic cables shall be per NECA/FOA 301-1997, Fiber Optic Cables, requirements.

C. Wiring shall be run in rigid metal raceway systems, underground conduit systems, or non-metallic FRP conduit systems, unless noted otherwise.

D. Install products in accordance with manufacturer’s instructions.

E. Minimum size of conductors shall be No. 12 AWG, unless specifically approved and/or shown otherwise on the Drawings.

F. Use stranded conductors for control circuits, No. 14 AWG minimum, unless shown otherwise on the Drawings.

G. Multi-conductor underground feeder, branch-circuit, and control cable shall meet the requirements of Article 340 of the National Electrical Code.

H. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 60 feet.

I. Use No. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.

J. Use No. 6 AWG conductors for 20 ampere, 120 volt branch circuits longer than 170 feet.

K. Use No. 4 AWG conductors for 20 ampere, 120 volt branch circuits longer than 270 feet.

L. Use No. 3 AWG conductors for 20 ampere, 120 volt branch circuits longer than 420 feet.

M. Where conductors or cables are to be installed in non-metallic raceway systems, the Contractor shall allow 24 hours, minimum, for all solvents to evaporate after cementing the last joint before pulling wires or cables.

N. Pull conductors into raceway at same time. Cable pulling tensions shall not exceed manufacturer's recommended values.

O. Use suitable wire pulling lubricant for wire, No. 4 AWG and larger, and for cables. No soap flakes, vegetable oils, clays, or grease shall be permitted in raceways.

P. Use suitable cable fittings and connectors.

Q. Neatly train and lace wiring inside boxes, equipment, and panelboards. Wires and cables shall be bundled and laced as specified in Section 26 05 33.23 - Surface Raceways for Electrical Systems.

R. Wires and cables routed through manholes, handholes, cable vaults, large pull boxes, and terminal cabinets shall be looped to provide two to three feet (minimum) of slack within the enclosure, where practical.

S. Clean conductor surfaces before installing lugs and connectors.

T. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

U. Wire and cable shall be supported in vertical runs by insulated clamps so that wire or cable weight will not be unduly supported from conductor terminations.

V. Spade or fork tongue lugs shall not be used, except where approved by Owner.

W. Conductor terminations and tap splices within lighting fixture pole/transformer bases shall be suitable for wet or damp locations.

X. Wires and cables shall, in general, be run continuously, without splicing, from origination to termination. No splices shall be permitted in any feeder circuit, except in outlet, junction, and/or pull boxes, or where specifically noted on the Drawings. Use sufficient length of wire for connecting to equipment without straining. Methods of splicing shall meet cable manufacturer's recommendations. Splices shall be carefully placed in outlet boxes, etc. without crowding. No splicing shall be permitted in signal cables.

Y. Splices and tap connections shall be made in junction boxes only; condulet type fittings shall not be used as junction boxes.

Z. Wires and cables shall be installed in raceways, as indicated on the Drawings or required, and shall provide a complete and operating system.

AA. Wires and cables shall be tagged as specified in Section 26 05 53 - Electrical Identification.

BB. Motor control center feeder circuits and distribution panelboard branch circuits shall each be run in individual raceways from source to motor or other load.

CC. Vertical lengths of wire and cable shall be supported as required by Article 300.19 of the National Electrical Code. Cable weight shall not be unduly supported from conductor terminations.

DD. Vertical lengths of exposed cable or cord runs over ten feet long shall be supported with a strain relief.

EE. Where an exposed run of cable or cord enters a box or enclosure, provide a watertight cord grip fitting suitable for the cable or cord diameter.

FF. 120 VAC, single phase loads shall be connected to provide a balanced load on the lighting transformers. 480 VAC, single phase loads shall be connected to provide a balanced load on the 480 VAC, three phase system.

GG. Make conductor length for parallel feeders identical on each phase leg.

HH. Feeders shall be connected for correct phase rotation. Where possible, busses shall be connected to result in the “A” or “X” phase being in the north, east, or top position with the other phases following in sequence. Terminals H1, H2, and H3 of transformers shall be connected to A, B, and C; 1, 2, and 3; or X, Y, and Z conductors, respectively, of incoming feeders.

II. Final connections to motors and other machinery, equipment and devices in hazardous areas which may be subject to movement or vibration may consist of a loop of mineral-insulated, metal-sheathed cable (Type MI) with UL listed fittings.

JJ. Secondary wire and cables run exposed through manholes, handholes, and cable vaults shall be fireproofed, where exposed. Fireproofing of wire and cables shall be accomplished with half lapped taping using fireproofing tape made of heat resistant organic fabric coated on one side with a flame-retardant elastomer. Fireproofing tape shall be held in place by spiral wrapping at recommended intervals using woven fiberglass tape.

3.05 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 26 05 53 - Electrical Identification.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.06 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Sections 01 45 00 - Quality Control and Section 26 07 05 - Electrical Testing and Equipment.

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values.

D. Verify continuity of each branch circuit conductor.

E. Verify continuity of each feeder conductor.

F. Communication cables shall be tested and certified by a qualified third-party after installation in accordance with industry standards, and copies of the certified test results turned over to Owner.

END OF SECTION

SECTION 26 07 05
ELECTRICAL TESTING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to perform electrical testing as shown on the Drawings, specified or required.

1. Building wire.
2. Underground feeder and branch circuit wire
3. Instrumentation cable
4. Communications cables
5. Wiring connectors and connections

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 00 - Quality Control

B. Section 26 05 00 - Common Work Results for Electrical

C. Section 26 05 10 - Basic Electrical Materials and Methods

D. Section 26 08 00 - Calibration and Start-up of Systems

1.03 REFERENCE STANDARDS

A. Testing methods shall be in conformance with the following documents:

1. National Electrical Code, latest approved edition.
2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
3. NETA Acceptance and Maintenance Specifications and Safety Guidelines.

B. Equipment shall be tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL, and OSHA, except as modified herein.

1.04 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data: Indicate electrical characteristics and specifications; including layout of switches, buttons, displays, dimensions, weights, and external power requirements; and, list cables, connections and all available accessories.

C. Test Results: Submit test results under provisions of Section 01 77 00 - Closeout Procedures.

D. Operation and Maintenance Data:

1. Submit under provisions of Section 01 77 00 - Closeout Procedures.
2. Operation Data: Include bound copies of operating and programming instructions.
3. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and use of product(s).

1.05 QUALITY CONTROL

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

B. Cable testing shall be performed by technicians certified in accordance with ANSI/NETA ETT-2000 Standards for the Certification of Electrical Testing Technicians. Technicians performing

these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make an informed judgment on the continued serviceability or non-serviceability of the specific equipment. Each on- site crew leader shall hold a current certification, Level III or higher, in electrical testing.

1.06 REGULATORY REQUIREMENTS

A. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.

B. Test instruments and devices shall be in conformance with all applicable standards and requirements of ISA, IEEE, ANSI, NEMA, and Underwriters Laboratories. NIST traceable certificates of calibration shall be provided with each instrument/device.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

B. Accept products on site in factory containers. Inspect for damage. Turn over to Owner immediately.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. The work shall include, but is not limited to, the following major items:

1. Programming.

2. Testing, Start-up, Demonstration, and Training for all electrical, instrumentation and controls equipment and/or systems furnished and installed as a part of Division 26.

PART 3 EXECUTION

3.01 TESTING

A. Contractor shall perform all testing necessary to ensure that the work performed under the Contract is satisfactory and in conformity with the requirements of the Contract Documents.

B. Testing shall be performed prior to start-up of equipment or systems.

C. Tests shall be witnessed by Owner and four (4) copies of all field tests, as specified herein and in other Sections, shall be submitted to Owner. Twenty-four (24) hours (minimum) written notice shall be given Owner prior to performing the tests. Such tests shall be scheduled at a time agreed upon by Owner and Contractor.

D. Testing shall include, but shall not be limited to, the following tests:

1. Insulation resistance to ground of conductors and equipment.

2. Continuity, connections, and integrity of the facility's entire grounding system.

3. Continuity, polarity, phase sequence, and connection of current carrying conductors and equipment.

4. Ground fault detection systems shall be tested in accordance with the NEC, UL, and manufacturer's recommendations.

5. Power Cable Tests shall be performed by a NETA full member testing company, supervised by a certified NETA testing leader, and made as follows:

a. New 480-volt feeder and branch circuit wires and cables between transformers and motor control center and distribution panelboard conductors shall be given a dielectric

absorption test. Dielectric absorption tests shall be made in accordance with NETA Acceptance and Maintenance Specifications and NETA Safety Guidelines.

b. Wire insulation tests shall be made with a 1000-volt megger on 480-volt power distribution cables and/or wires. Each test shall be continued for a time sufficient to charge the cable or wire.

6. The following information shall be included in a test report on each cable:

a. Complete identification of cable, including approximate length.

b. Approximate average cable temperature.

c. Megger readings versus time data, including converted values (480-volt cables only).

7. In order to be acceptable, cable must withstand the specified high voltage without breakdown or have satisfactory megger readings.

E. Improper connections, or materials, and equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by Contractor and re-tested at no additional cost to Owner.

3.02 CONTRACTOR'S ASSISTANCE

A. Completely and thoroughly swab raceway before installing wire.

B. Testing of package equipment shall be as required in other Sections.

C. Provide the services of an electrician to assist either Contractor or the equipment manufacturer's service representatives on field test and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is put into service. Contractor shall make equipment manufacturers' service representatives available as required to assist in testing or putting equipment into operation.

3.03 DEMONSTRATION

A. After acceptance of the test equipment, Owner’s operators shall be provided with one day (in two 1/2-day sessions) of onsite training in the use and maintenance of each piece of the equipment. Training shall cover the operation of the test equipment, preventative maintenance of equipment, and troubleshooting and repair/replacement procedures.

END OF SECTION

SECTION 26 07 05.10
ELECTRICAL TEST CERTIFICATES

Device Settings Certificate For Motor Protection Relay (MPR)

TECHNICIAN INFORMATION

Company Name: _____

Contact Person: _____

Address: _____

Phone Number: _____

EQUIPMENT IDENTIFICATION

Starter or Panel Designation: _____

DEVICE SETTINGS

Attach Manufacturer's form(s), with settings filled in, whenever available.

MPR Settings			
Device ID		Jam Trip Run Delay in Seconds	
Manufacturer		Underload Trip Level in % of FLA	
Model No.		Underload Trip and Alarm Start Delay in Seconds	
Full Load Amp Rating		Underload Trip Run Delay in Seconds	
Locked Rotor Current in % of FLA		Phase Unbalance Trip Level	
Maximum Allowable Stall Time in Seconds		Phase Unbalance Trip and Alarm Start Delay in Seconds	
Ultimate Trip Current in % of FLA		Phase Unbalance Trip Run Delay in Seconds	
Phase CT Ratio		Ground Fault Alarm Level in % of Ground CT Ratio	
Ground CT Ratio			

CERTIFICATION

I certify that the above information is correct and that the instrument installation conforms to manufacturer and Contract Specifications, unless otherwise noted.

Technician Signature: _____

Date: _____

ENGINEER REVIEW

Calibration Witnessed: _____ Yes _____No

Reviewer Signature: _____

Date: _____

Device Settings Certificate for Circuit Breakers

TECHNICIAN INFORMATION

Company Name: _____

Contact Person: _____

Address: _____

Phone Number: _____

EQUIPMENT IDENTIFICATION

Starter or Panel Designation: _____

DEVICE SETTINGS

Attach Manufacturer's form(s), with settings filled in, whenever available.

CERTIFICATION

I certify that the above information is correct and that the instrument installation conforms to manufacturer and Contract Specifications, unless otherwise noted.

Technician Signature: _____

Date: _____

ENGINEER REVIEW

Calibration Witnessed: _____ Yes _____No

Reviewer Signature: _____

Date: _____

Device Settings Certificate for Variable Frequency Controller

TECHNICIAN INFORMATION

Company Name: _____

Contact Person: _____

Address: _____

Phone Number: _____

EQUIPMENT IDENTIFICATION

Starter or Panel Designation: _____

DEVICE SETTINGS

Attach Manufacturer's form(s), with settings filled in, whenever available.

CERTIFICATION

I certify that the above information is correct and that the instrument installation conforms to manufacturer and Contract Specifications, unless otherwise noted.

Technician Signature: _____

Date: _____

ENGINEER REVIEW

Calibration Witnessed: _____ Yes _____No

Reviewer Signature: _____

Date: _____

END OF SECTION

SECTION 26 07 10
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to demonstrate equipment and/or systems for Owner's personnel as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 00 - Quality Control

B. Section 01 77 00 - Closeout Procedures

C. Section 26 05 00 - Common Work Results for Electrical

D. Section 26 05 10 - Basic Electrical Materials and Methods

E. Section 26 07 05 - Electrical Testing and Equipment

F. Section 26 08 00 - Calibration and Start-up of Systems

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electric Code (NEC)

B. Federal, State, and/or local codes, ordinances, or regulations.

C. Equipment shall be designed, constructed, installed, and tested in conformity with requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL and OSHA, except as modified herein.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DEMONSTRATION OF EQUIPMENT

A. Demonstration of equipment and systems, and training of Owner's personnel in the proper operation and maintenance of the equipment and systems, shall be performed as described below, and per the requirements of the Section under which the equipment/system was furnished.

B. The following shall occur prior to scheduling demonstration and training of equipment and/or system:

1. Contractor shall have fully complied with the requirements of 26 07 05 - Electrical Testing and Equipment and Section 26 07 05.10 - Electrical Test Certificates and shall have submitted reports indicating successful completion of start-up for the equipment/system being started.

2. Deficiencies in the manufacturer's Operation and Maintenance (O&M) Manuals and/or “As-Built” drawings, noted during Start-up shall be corrected prior to scheduling Owner's demonstration and training, as required per 26 07 10 - Demonstration and Training.

C. After completing the above items, the Contractor shall schedule Owner's demonstration and training. Seventy-two (72) hours (minimum) written notice shall be given Owner's Representative prior to performing any demonstration and/or training. Such sessions shall be scheduled at a time agreed upon by Owner and Contractor. Multiple sessions shall be scheduled to allow attendance by Owner’s personnel.

D. Demonstration shall instruct Owner's personnel in facets, features and functions of the operation of the equipment and/or system. Training shall be performed using the manufacturer's Operation and Maintenance Manual and “As-Built” drawings, and shall

familiarize Owner's personnel in identifying improper operation, troubleshooting for the cause(s), and performing repair, replacement, and recalibration/setup necessary to correct the mis-operation. Use of test equipment necessary, and a review of recommended and/or provided spare parts shall be included in the training.

E. Verification of the demonstration and training for the equipment and/or system shall be provided in the form of a report, indicating that Owner's personnel attended and witnessed all functions and operations required of the equipment and/or system, and received the required instruction. Demonstration and Training will be witnessed by Owner's Representative and four (4) copies of demonstration and training reports, as specified above and in other Sections, shall be submitted to Owner.

F. Successful and approved completion of the Demonstration and Training requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete.

3.02 CONTRACTOR'S ASSISTANCE

A. Demonstration and training of package equipment, as described herein shall be as required in other Sections.

B. Contractor shall provide the services of an electrician to assist either Contractor or the equipment manufacturers' service representatives on field set-ups and adjustments as may be required to demonstrate operation of the equipment or system. Contractor shall make equipment manufacturers' service representatives available as required to assist in demonstrating equipment operation.

3.03 CLEANUP

A. Cleanup shall occur as required under Section 01 77 00 - Closeout Procedures.

3.04 ACCEPTANCE

A. Acceptance shall occur after the above requirements have been satisfied, and as per Section 01 77 00 - Closeout Procedures.

B. Acceptance of equipment and/or systems shall be signified by execution of guarantees as described below.

3.05 GUARANTEES

A. Equipment and installation furnished under Division 26 shall be guaranteed for a period of one (1) year as specified under Section 01 77 00 - Closeout Procedures.

B. Contractor's Guarantee shall be furnished as follows:

1. Provide multiple copies.
2. Execute for Owner's signature a certificate of Contractor's guarantee, listing date of acceptance as start of warranty period (except where indicated otherwise under the detailed equipment specifications), for work and materials provided and installed under this Division.
3. Execute and assemble transferable warranty and/or license documents from Subcontractors, suppliers, and manufacturers.
4. Provide Table of Contents and assemble in three D, side ring binder with durable plastic cover.

C. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of Owner’s acceptance as start of warranty period.

D. Owner's dated signature on these documents shall constitute acceptance for warranty purposes.

END OF SECTION

SECTION 26 08 00
CALIBRATION AND START-UP OF SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to calibrate and start-up specified equipment and/or systems as shown on the Drawings, specified or required.

B. This Section includes:

1. Requirements for setup and calibration of devices and instruments.
2. Requirements for start-up of systems furnished/installed under this Contract.
3. Calibration equipment requirements.
4. Sample Forms.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 00 - Quality Control

B. Section 26 05 00 - Common Work Results for Electrical

C. Section 26 05 10 - Basic Electrical Materials and Methods

D. Section 26 07 05 - Electrical Testing and Equipment

E. Section 26 08 00 - Calibration and Start-up of Systems

1.03 REFERENCE STANDARDS

A. Setup, calibration, and workmanship shall be in conformance with the following documents:

1. NFPA 70 - National Electric Code (NEC)
2. Federal, State, and/or local codes, ordinances, or regulations.

B. Equipment shall be designed, constructed, installed, and tested in conformity with requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL and OSHA, except as modified herein.

1.04 SUBMITTALS

A. Product Data: Indicate electrical characteristics and specifications; including layout of switches, buttons, displays, dimensions, weights, and external power requirements; and, list cables, connections and all available accessories.

B. Submit calibration, setup and programming documentation under provisions of Section 01 77 00 - Closeout Procedures.

C. Operation Data: Include bound copies of operating and programming instructions. Include component parts replacement, adjustments, and preventative maintenance procedures and materials.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and use of product(s).

1.05 QUALITY CONTROL

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

1.06 REGULATORY REQUIREMENTS

A. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.

B. Instruments and devices shall be in conformance with applicable standards and requirements of ISA, IEEE, ANSI, NEMA, and Underwriters Laboratories.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

B. Accept products on site in factory containers. Inspect for damage.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 START-UP REQUIREMENTS

A. Setup, calibration and start-up of equipment and/or systems shall be performed as described below, and per the requirements of the Section under which the equipment/system was furnished.

B. Contractor shall also verify operation of the facility's main control and monitoring systems, and coordination with all other equipment and sub-systems.

C. Prior to scheduling Start-up of any equipment and/or system, Contractor shall have complied with the requirements of Section 26 07 05 - Electrical Testing and Equipment and shall have submitted reports indicating successful completion of testing for the equipment/system being started.

D. Prior to energizing and operating any equipment or system, Contractor shall arrange for the manufacturer's representative to inspect the installation for compliance to the manufacturer's recommendations. As a part of this inspection, Contractor and/or the manufacturer's service personnel shall set protective devices as required by the Short Circuit, Flash Hazard, and Protective Devices Coordination Analyses specified under 26 07 05 - Electrical Testing and Equipment.

E. Contractor shall energize the equipment/system and perform setting of equipment limit and safety switches. Calibration of sensing relays, and timer/sequencer, etc. settings, along with programming required for proper operation shall be made at this time. Contractor shall then start-up the equipment/system and verify the proper operation of all features and functions as required by the Specifications and Drawings.

F. After completing the above items, the Contractor shall schedule a "Witnessed" Start-up. Twenty-four (24) hours (minimum) written notice shall be given to Owner prior to performing any start-up. Start-up shall be scheduled at a time agreed upon by Owner and Contractor.

G. Start-up and operation of the equipment and/or system shall be performed using the manufacturer's Operation and Maintenance Manual. Deficiencies in the O&M Manual noted during start-up shall be corrected prior to scheduling Owner’s demonstration as specified under Section 26 07 10 - Demonstration and Training. Start-up will be witnessed by Owner.

H. Verification of the start-up performance of the equipment and/or system shall be provided in the form of a start-up report, indicating that Owner’s witnessed all functions and operations required of the equipment and/or system. Four (4) copies of start-up reports, as specified herein and in other Sections, shall be submitted to Owner.

I. Improperly functioning equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any

changes or repairs necessary to put the work in satisfactory condition and operation shall be done by Contractor at no additional cost to Owner. Start-up of the repaired equipment/system shall be witnessed by Owner.

J. Successful and approved completion of the start-up requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete as specified under Section 26 07 10 - Demonstration and Training.

3.02 CONTRACTOR'S ASSISTANCE

A. Setup, calibration, and start-up of equipment as described in Section 26 07 05 - Electrical Testing and Equipment, shall be as required in other Sections.

B. Contractor shall provide the services of an electrician to assist either Contractor or the equipment manufacturers' service representatives on field tests and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is started up. Contractor shall make equipment manufacturers' service representatives available as required to assist in putting equipment into operation.

3.03 DEMONSTRATION

A. Turn over the calibration equipment at the time of, and as a condition of, acceptance.

B. After acceptance of the calibration equipment, Owner's operators shall be provided with one day (in 1/2-day sessions) of onsite training in the use and maintenance of each piece of the equipment. Training shall cover the operation of the calibration equipment, preventative maintenance of equipment, and troubleshooting and repair/replacement procedures.

END OF SECTION

SECTION 26 09 00
INSTRUMENTATION AND CONTROL FOR ELECTRICAL SYSTEMS - GENERAL

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes general requirements for electrical power, instrumentation, and controls systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 45 00 - Quality Control

B. Section 26 05 00 - Common Work Results for Electrical

1.03 REFERENCE STANDARDS

A. Equipment and workmanship shall be in conformance with the following documents:

1. NFPA 70 - National Electric Code (NEC)

2. Federal, State, and/or local codes, ordinances, or regulations.

B. Equipment shall be designed, constructed, installed, and tested in conformity with requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL and OSHA, except as modified herein.

1.04 GENERAL REQUIREMENTS

A. Unless otherwise specified, provide tools, equipment, apparatus, transportation, labor, and supervision to complete and place in satisfactory operation the work indicated on the Drawings and specified herein. Where permits or inspection fees are required in connection to the work under this Specification, Contractor shall secure such permits and pay all fees.

B. Where public or private utilities are encountered, Contractor shall be responsible for any damages thereto resulting from his operations. Existing lines or utilities damaged during the construction, and which are not to be abandoned or removed, shall be replaced or repaired. Contractor shall be responsible for determining the exact location of all underground or otherwise concealed utilities, conduit runs, piping, etc. which may interfere with construction, or which require modifications.

C. Work shall be done in conformity with the applicable requirements of the codes, rules, and regulations of public utilities and all others having jurisdiction.

D. Where the Specifications describe or the Drawings show materials of higher quality than required by the above rulings and codes, the Drawings and Specifications shall govern the quality of materials which shall be furnished.

E. Wire, conduit, and equipment sizes shown on the Drawings are based on estimated ratings. If ratings of equipment as furnished under the Contract exceed the estimated ratings, the wire, conduit, and equipment sizes shall be adjusted to meet NEC requirements at no additional cost to Owner.

F. The phrase "below grade," when used in reference to the interior of buildings, rooms, or other structures in these Specifications and on the Drawings, shall apply to the entire internal volume of the room, area, or structure where 50 percent or more of the volume is actually below the average of the exterior finished grade elevations. In other cases, the phrase shall only apply to the volume of space actually below finished grade.

G. Dry locations are defined as interior; above grade; heated rooms, structures, buildings, cabinets, enclosures, etc. not normally subject to dampness or wetness. Damp locations are defined as interior; above grade; unheated rooms, structures, and buildings. Wet locations are defined as all outdoor areas; all underground rooms, structures, building areas, vaults, etc.;

whether heated or unheated. Refer to National Electrical Code Article 100, “Location:” for additional definitions.

1.05 PROJECT CONDITIONS

A. Before submitting his proposal, Contractor shall be held to have examined the site and satisfied as to the existing conditions under which Contractor will be obliged to work. Contractor will be allowed no claim(s) for extra(s) due to Contractor’s failure to make the above examination.

1.06 INSPECT

A. At the proper time, Contractor shall file application for inspection of his work with the local, State, or National authority having jurisdiction and shall deliver to Owner required certificates attesting to approval by such authorities.

1.07 GUARANTEE

A. The equipment and installation furnished under this Section shall be guaranteed for a period of one (1) year as specified under Section 01 77 00 - Closeout Procedures, except as modified by the Division 26 specifications.

B. Repair and maintenance for the guarantee period is the responsibility of Contractor and shall include all repairs and maintenance other than that which is considered as routine (This is replacement of lamps, oiling, greasing, etc.). Owner shall be the judge of what shall be considered as routine maintenance.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, except where specifically identified otherwise.

B. Materials and equipment shall be listed or labeled by Underwriters’ Laboratories, Inc., except for materials and equipment not available from any source with such listing and/or labeling, or as specifically required by the Division 26 Sections.

C. Conductor terminations, lugs, and connectors on all equipment supplied under this Contract shall be 75 degrees Celsius rated for copper conductors.

D. Concrete for electrical work shall be ready-mix or transit mixed concrete to the requirements of ASTM C94/C94M, latest edition. Concrete shall have a compressive strength, after twenty-eight (28) days, of 3,500 psi (minimum).

2.02 LOOSE AND DETACHABLE PARTS

A. Contractor shall retain loose and small detachable parts of the apparatus and equipment furnished under his Contract, until the completion of his work, and shall then turn same over to Owner or Owner's representative delegated to receive them and obtain from Owner an itemized receipt, therefore, in triplicate, Owner retaining the original. Contractor shall retain one copy of this receipt for his files and shall attach the other two to any request for final payment for the work.

2.03 STANDARDS

A. Materials shall be new and shall conform as a minimum with NEMA, ANSI, and Underwriters Laboratories, Inc. (UL) in every case where such a standard has been established for the particular type of material in question.

2.04 SPARE PARTS

A. Spare parts shall be provided for electrical equipment supplied under this Contract, as specified in individual Specification Sections, and shall be furnished and delivered to Owner. Spare fuses are specified under Section 26 07 05 - Electrical Testing and Equipment.

B. Spare parts shall be packed and individually boxed for storing with each box labeled with the part's description including its part or catalog number, its use, and the equipment for which it is a part. Parts used during startup shall be replaced prior to acceptance.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Floor-mounted equipment shall be provided with a minimum 4-inch-high concrete pad, unless a higher dimension is shown (or called for) on the Drawings.

B. Material and equipment furnished and installed by Contractor shall be completely protected against damage, pilferage, dampness, or abuse until turned over and accepted by Owner.

C. Concrete shall be maintained in moist condition for at least five (5) days after placement, by means approved by Owner.

D. The installation of all electrical, instrumentation, and control equipment shall meet the requirements of the State and Federal Occupational Safety and Health Statutes.

3.02 DRAWINGS AND MEASUREMENTS

A. Equipment is shown in its general location, except where in certain cases the Drawings may include details giving the exact location and arrangement. Existing, underground or otherwise concealed utilities, piping, conduit runs, etc. indicated on the Drawings are shown in approximate locations and orientations only; Contractor shall field verify exact locations.

B. Drawings shall be submitted in accordance with Sections 01 33 00 - Submittal Procedures and 01 77 00 - Closeout Procedures of these Specifications and as specified herein. No work shall be undertaken until Engineer has reviewed and approved the shop drawings. Only approved materials shall be installed, and only approved installation methods shall be used.

C. Contract Drawings show the arrangement, general design, and extent of the systems.

D. The Work is shown on the Drawings by symbols, as shown in a legend on the Drawings.

E. Contract Drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by Contractor. Field measurements necessary to determine the required quantities of materials and fitting the installation of all materials and equipment into the building construction shall be taken by Contractor.

F. Installation drawings and manufacturer's shop drawings are required for all electrical, instrumentation, and control work. Installation drawings shall show panel layout, conduit connection sizes, and location and equipment foundations, details, and locations, accurately dimensioned. Exposed runs of conduit need not be dimensioned. Conduit layout and installation drawings shall be submitted for approval and shall show all conduit runs, complete from origination to termination, and shall indicate conduit sizes and fills, raceway system components, methods and spacing of supports, etc.

G. Control schematics shall be provided for all new and modified existing control circuits. Control schematics shall use the ladder diagram type format incorporating line numbers, operation function statements, contact location line numbers with underlines indicating normally closed contacts. A description of operation of each device and complete written sequence of operation shall be provided with all control schematics. Format and symbols shall be as approved by Owner. Wire and terminal numbers shall be clearly shown.

H. Upon completion of the work, complete record drawings shall be provided in accordance with Section 01 77 00 - Closeout Procedures.

3.03 STORING OF EQUIPMENT

A. Equipment shall be stored in accordance with the manufacturer's recommendations. A letter from the manufacturer shall be provided stating those recommendations.

B. Equipment which has been set in place but not in operation shall be protected from damage or deterioration from whatever causes in accordance with the manufacturer's recommendations until the equipment has been accepted by Owner.

C. Wire and cable shall be stored on the original, manufacturer's reels, protected from the weather, and all cable end seals shall be maintained intact until the cable is installed.

D. During construction, electrical equipment insulation shall be protected against absorption of moisture and metallic components shall be protected against corrosion by strip heaters, lamps, or other acceptable means. This protection shall be provided immediately upon receipt of the equipment and maintained continuously.

3.04 CLEANUP

A. After substantial completion and prior to final acceptance, all electrical equipment shall be cleaned up, interior and exterior, to be free of dust and other foreign matter. Internal components shall be vacuumed, including windings of dry type transformers, and wiped free of dust.

B. De-energization of equipment to accomplish the cleaning work shall be done at a time as approved by Owner.

3.05 PAINTING

A. Exterior of enclosures shall be cleaned and touched up with matching paint where scratched or marred so that the exterior presents an "as new" appearance.

B. Factory finished equipment shall be protected from damage during erection, thoroughly cleaned after erection, and touched up as required. If the factory finish has, in the opinion of Owner, been seriously damaged, the equipment shall be refinished as specified in Section 09 96 00 - Painting.

3.06 SALVAGED ELECTRICAL EQUIPMENT

A. Electrical equipment in the existing treatment facility that is removed and not reused shall be turned over to Owner or disposed of as directed by Owner.

3.07 SUBSTANTIAL COMPLETION

A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete, in accordance with the Contract Documents, such that Owner can occupy the facilities and/or utilize the system for its intended use.

B. Substantial Completion shall be determined by Owner and/or Engineer based on completion of Testing, Start-up, and Demonstration requirements as specified in Sections 26 07 05 - Electrical Testing and Equipment, 26 07 10 - Demonstration and Training, and 26 08 00 - Calibration and Start-up of Systems. See Section 01 77 00 - Closeout Procedures for additional requirements.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide distribution panelboards and lighting panelboards as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 53 - Electrical Identification

D. Section 26 24 16.13 - Panel Components and Devices

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction

B. NEMA AB 1 - Molded Case Circuit Breakers

C. NEMA PB 1 - Panelboards

D. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

E. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

B. Manufacturer‘s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

C. Record Drawings: Record actual locations of Products; indicate actual branch circuit arrangement.

D. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 QUALITY CONTROL

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products as required by manufacturer.

B. Accept products on site in factory containers and inspect for damage.

PART 2 PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

A. The distribution panelboards shall be NEMA Type 12 rated and shall have overall doors. Boxes shall be made of galvanized steel and the fronts and doors shall be made of painted steel. The fronts shall be designed for surface or floor mounting as shown on the Drawings. The doors shall be equipped with flush hinges and locks. All locks shall be keyed alike and six keys shall be furnished and delivered to the Owner. Glazed directory frames and cards designating the branch circuits shall be mounted on the inside of each of the cabinet doors. The door and panel trim shall be given one primer coat and not less than two coats of ANSI 61 paint. The panelboards shall have ground buses for terminating ground conductors.

B. The panelboards shall be of the circuit breaker type and shall be designed for 600 volt, 3 phase, 3 wire, 60 Hertz alternating current service, and shall be service entrance rated. The panelboards shall be equipped with main circuit breaker and bus and branch circuits of sizes as shown on the Drawings. Feed through lugs, sized the same as the main lugs, shall be included where space limitations require additional panelboard section(s) to accommodate the scheduled branch circuit breakers. All panelboard bus work shall be copper and all terminals or lugs shall be 75°C rated for copper conductors.

C. The circuit breakers shall be of the molded case, bolt-in-place type with thermal magnetic trip and shall be 600 volt, quick-make, quick-break with indicating trip and 25,000 A. interrupting capacity minimum at 480 volts. Breaker handles shall clearly indicate the “on”, “off”, and “tripped” positions. Each circuit breaker shall be provided with a padlockable handle lock hasp.

D. The panelboards shall be Eaton Cutler-Hammer, Square D by Schneider Electric Type NF, or General Electric.

2.02 PACKAGE POWER UNITS

A. Package power units shall be listed by Underwriters' Laboratories, Inc., and shall feature a self-contained indoor/outdoor non-ventilated enclosure that incorporates a primary breaker, a dry type transformer, a secondary main breaker, and a secondary distribution section with plug-in feeder breakers.

B. All interconnecting wiring between the primary breaker and transformer and between the transformer and secondary main breaker and distribution section shall be factory installed and inspected prior to shipment. Sound levels must fall within NEMA-ANSI standard levels according to kVA size.

C. The transformer design shall be listed by UL and built in accordance with the latest revision of NEMA ST 1-4 and ANSI Standards for general purpose specialty transformers. Core and coil treatment shall be by immersion in an insulating resin system of the class equal to the temperature rise and shall be cured at temperatures to result in complete encapsulation of core and coil.

D. All transformer, circuit breaker, and bus terminals or lugs shall be 75ºC rated. All panelboard and transformer bus work shall be tinned copper.

E. The transformer shall be 15 kVA; 115ºC temperature rise, 480 volt, single phase primary; and 120/240 volt, single phase, 3 wire secondary.

F. The secondary main breaker shall be 2 pole, sized to provide protection for the distribution feeder section.

G. The primary of the transformer shall be protected by a molded case, thermal magnetic breaker. The primary breaker shall provide additional branch circuit protection and disconnecting means, as well as supplemental short circuit and overload protection for the transformer.

H. The secondary distribution section shall accommodate one inch, plug-in breakers with 10,000 ampere interrupting capacity. Single pole and two pole breakers shall be provided as indicated on the Drawings. Primary, secondary main, and secondary feeder breakers shall have a hinged access door. The door shall have provisions for padlocking. Enclosure shall be NEMA Type 3R.

I. Package power units shall be Square D by Schneider Electric Mini Power Zone, Hubbell -Acme Electric Panel Tran, Eaton Cutler-Hammer Mini Power Center, General Electric Service Center, or equal.

2.03 MODIFICATIONS TO EXISTING PANELBOARDS

A. Where indicated on the Drawings, provide modifications to existing panelboards as required. The panelboards shall be modified by the addition of new devices, connections to existing devices, and/or disconnection from existing devices.

B. Circuit breakers for addition to existing panelboards shall be the panelboard manufacturer`s compatible replacement parts and shall match the panelboards existing breaker interrupting ratings. Breaker trip ratings and number of poles shall be as indicated on the Drawings.

C. Existing lighting panels are General Electric, 120/208 volt, 3 phase, 4 wire panelboards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and NECA 407-2015, Panelboards.

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.

C. Wall Mounting Height: 6 feet (2 m) to top of panelboard; install panelboards taller than 6 feet (2 m) with bottom no more than 4 inches (10 cm) above floor.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Panelboard circuit breakers or switches shall have a circuit number marker on or adjacent to the breaker or switch.

G. Provide engraved plastic nameplates and circuit number markers under the provisions of Section 26 05 53 - Electrical Identification.

H. Arc-flash and shock hazard warning labels shall be provided on the door of each panelboard.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

END OF SECTION

SECTION 26 24 16.13
PANEL COMPONENTS AND DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide panel components and devices, and associated appurtenances as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 07 05 - Electrical Testing and Equipment

B. Section 26 07 10 - Demonstration and Training

C. Section 26 08 00 - Calibration and Start-up of Systems

D. Section 26 09 00 - Instrumentation and Control for Electrical Systems - General

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electric Code (NEC)

B. NEMA ICS 1 - Industrial Control and Systems General

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

D. NEMA ICS 6 - Industrial Control and Systems: Enclosures

1.04 REGULATORY REQUIREMENTS

A. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.

B. Equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.

C. Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.

1.05 SUBMITTALS

A. Shop Drawings: Shop drawings shall indicate electrical characteristics and connection requirements, including layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied.

B. Product Data: Provide product data showing manufacturer's specifications, electrical characteristics, and connection requirements for each product supplied. Include application and installation instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or testing agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each product supplied.

C. Record Documents: Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

D. Operation and Maintenance Data:

1. Installation and start-up requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.

2. Maintenance data shall include component parts diagrams and lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

1.06 QUALITY CONTROL

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products as required by manufacturer.

1. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

B. Accept products on site in factory containers and inspect for damage.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Panel components and devices shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described hereinbelow. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.

B. Maintain instruments free of dirt and dust during and after installation.

PART 2 PRODUCTS

2.01 INSTRUMENT AND CONTROL PANELS - GENERAL

A. Instrument and control panels shall be furnished as described in Section 26 41 16 - Panelboards, and as indicated on the Drawings.

2.02 TERMINAL BLOCKS – 600 VOLTS AND LESS

A. Terminal blocks shall be as manufactured by Allen Bradley 1492-CA1 or equal by Eaton Cutler-Hammer or Square D.

B. Each wire for external connection, and other wiring inside enclosures requiring terminal blocks, shall be terminated on screw type compression terminal blocks rated at 600 VAC. Fused terminals shall match the terminal blocks and shall be complete with fuse puller, and fuse.

C. All foreign circuit 120 VAC wiring shall be yellow and each foreign circuit shall be provided with a clearly labeled circuit disconnect switch. Foreign circuit disconnect switches shall be switch type terminal blocks complete with engraved nameplates.

D. Ten percent spare terminals of each type shall be provided.

2.03 POWER DISTRIBUTION BLOCKS – 600 VOLTS AND LESS

A. Power distribution blocks shall be as manufactured by Allen Bradley 1492-PD type or equal by Eaton Cutler-Hammer or Square D.

B. Where power is to be distributed among many circuits this shall be accomplished using one, two, or three pole power distribution blocks. The blocks shall be rated for use at 600 VAC and shall have copper connector block construction.

2.04 MANUFACTURERS (SWITCHES AND INDICATING LIGHTS)

A. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 1, or NEMA Type 12, enclosures shall be of dust-tight, oil-tight NEMA Type 13 design; as

manufactured by Allen-Bradley Bulletin 800T, Eaton Cutler-Hammer 10250T Series, or Square D Type K.

B. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 3R, or NEMA Type 4, enclosures shall be of watertight, NEMA Type 4 design; as manufactured by Allen-Bradley Bulletin 800T, Square D Type K, Eaton Cutler-Hammer 10250T Series with clear rubber boot and gaskets.

C. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 4X enclosures shall be of watertight, corrosion resistant, NEMA Type 4X design; as manufactured by Square D Type SK, Allen-Bradley Bulletin 800H with clear rubber boot and gaskets, or Eaton Cutler-Hammer 10250T Series with clear rubber boot and gaskets.

D. Push-button switches, selector switches, and indicating lights mounted on explosion proof, (Class I, Div. 1, Groups C and D) enclosures shall be of explosion proof design, rated for Class I duty; as manufactured by Allen-Bradley Bulletin 800H, Square D Type BR, Crouse-Hinds Types EFS and EFD, Appleton EFD and EDS Series, or equal by Killark.

E. Four or more position selector switches shall be rated as indicated above, as a minimum, with the number of contacts as required by the Drawings, shall have pistol grip type handles and shall be as manufactured by Electro Switch Type W-2, American Solenoid Blue Line Type C10, or equal.

2.05 INDICATING LIGHTS (LT)

A. Indicating lights shall be LED, heavy duty, push-to-test, transformer type with lens colors as shown on the Drawings.

B. Indicating lights shall be equipped with legend plates marked as shown on the Drawings and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

2.06 SELECTOR SWITCHES (SS)

A. Selector switches shall be of the two or three position, maintained contact, heavy duty type, with contact arrangement as shown on the Drawings. The contacts shall be rated at least 10 amperes at 600 VAC.

B. The selector switches shall be equipped with legend plates marked as shown on the Drawings and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

2.07 PUSH-BUTTON SWITCHES (PB)

A. Push-button switches shall be of the heavy duty, momentary contact, industrial type rated for 600 VAC, and the contacts shall be rated for 10 amperes continuous duty at 125 VAC. Push-button switches shall be the guarded type with full shroud and green button for start operation, the unguarded type with red button for stop operation, and the unguarded type with black or gray button for all others.

B. Push-button switches shall be equipped with legend plates marked as shown on the Drawings and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

2.08 EMERGENCY STOP-RESET/JOG PUSHBUTTON SWITCH STATIONS (ESRJ)

A. Emergency stop-Reset/Jog pushbutton switch stations shall be of the three push-button operator type with padlocking provision on the Stop button. The switches shall be of the momentary (Reset and Jog buttons) – maintained (Stop button) type. The Stop and Reset operators shall be mechanically interlocked.

B. Stations shall be rated for installation in hazardous locations; Class I, Division 1; where indicated as explosion proof; and shall be rated NEMA 4X for all other locations.

C. Station enclosure shall be constructed of cast, copper-free aluminum with a corrosion resistant finish.

2.09 STOP-LOCKOUT SWITCH STATIONS

A. Wherever “Emergency stop-Reset”, “Emergency stop lockout”, “Lock stop-Reset”, “Stop lockout-Reset”, or “Stop-Reset” pushbuttons are shown on the Drawings, they shall be two unit, mechanically interlocked, maintained contact type with locking device on stop button, and legend plates shall be “Stop” or “Emergency stop”, as indicated on the Drawings, and “Reset”.

B. Stations shall be rated for installation in hazardous locations; Class I, Division 1; where indicated as explosion proof; and shall be rated NEMA 4X for all other locations.

2.10 REMOTE CONTROL STATIONS

A. Control stations shall be provided and installed where indicated on the Drawings and shall contain the control devices indicated.

B. Stations shall consist of switches and/or indicating lights mounted in a NEMA Type 4X, or explosion proof enclosure, as indicated on the Drawings. Station enclosures shall be designed for mounting of the control devices required and shall have nameplates as required and specified under Section 26 05 53 - Electrical Identification.

2.11 LOGIC RELAYS (LR)

A. Logic relays shall be of the miniature plug-in relay type, suitable for logic duty, with contacts rated not less than 3 amperes at 120 VAC.

B. The relay coils shall be rated for continuous duty at 120 volts, 60 Hertz. Each logic relay shall have an internal pilot light for indication of coil energization.

C. The contact arrangement shall be 4PDT. Each relay shall also have a manual operator, to provide for testing the logic circuits by manually operating the contacts.

D. Each logic relay shall be complete with a double tier, 14 pin (spade type), plug-in base. The bases shall be suitable for either surface or track mounting. Each relay shall be provided with a hold-down device.

E. Logic relays shall be as manufactured by Square D Class 8501 Type R, Allen-Bradley Bulletin 700 Type P, or equal by IDEC or Potter and Brumfield a Division of Tyco Electronics.

2.12 CONTROL RELAYS (CR)

A. Control relays shall be of the heavy duty, industrial type with convertible contacts rated not less than 10 amperes at 600 volts AC.

B. The relay coils shall be of molded construction and shall be rated for continuous duty at 120 volts, 60 Hertz, alternating current.

C. The contact arrangement shall be as required.

D. NEMA Type 12 enclosures shall be provided for relays where shown on the Drawings.

E. Induction relays shall be electro-mechanical type, 120 VAC powered with secondary coil voltage of 24 VAC and one N.O. and one N.C. contact rated 8 amps (min.) at 120 VAC. Induction relay sensitivity shall be field adjustable. Unit shall be suitable for use with contact closure devices.

F. Control relays shall be as manufactured by Square D Class 8501 Type X, Allen-Bradley Bulletin 700 Type P, Eaton Cutler-Hammer Type ARB, or equal by General Electric.

G. Induction relays shall be as manufactured by B/W Controls Model 1500-A-L1-S2-DC-X, or Warrick Controls equivalent.

2.13 ALTERNATING RELAYS (ALT)

A. Duplex alternating relays shall be designed to alternate control of two loads through DPDT contacts. The relays shall be suitable for operation on 120 VAC. The contacts shall transfer on each pulse when the relay's control input is de-energized and shall be rated 5 amps (minimum) at 120 VAC resistive.

B. Triplex alternating relays shall be designed to alternate control of three loads through SPST contacts. The relays shall be suitable for operation on 120 VAC. The contacts shall transfer on each pulse when the relay's control input is de-energized and shall be rated 2 amps (minimum) at 120 VAC resistive.

C. The minimum life expectancy of the alternating relays shall be one million operations and each relay shall be equipped with screw terminals for direct wiring.

D. Duplex alternating relays shall be as manufactured by Diversified Electronics Model No. ARA-120-ADA, or equal, by Time Mark.

E. Triplex alternating relays shall be as manufactured by Diversified Electronics Model No. ARA-120-AFE, or equal, by Time Mark.

F. Durant/Eagle Signal Model B856-511, or equal, with plug-in base and HOLD DOWN.

2.14 PHASE MONITOR RELAYS (PMR)

A. Phase monitor relays shall sense phase loss, incorrect phase sequence, and low phase voltage and shall have double pole, double throw contacts. Relays shall operate on an adjustable voltage range of 440 volts to 480 volts. Relays shall have a delay on trip, field adjustable 1 to 10 seconds (minimum) and shall automatically reset when voltage returns to normal. Phase monitor relays shall detect phase loss with regenerated voltages present.

B. Phase monitor relays shall be as manufactured by Diversified Electronics, Inc. No. SLD-440-ALE, or Time Mark Corp. Model C2642.

C. Load monitor relays shall be as manufactured by Diversified Electronics, Inc. No. CBA-102-ALE-5, or equal.

2.15 LOAD MONITOR RELAYS (LMR)

A. Load monitor relays shall be on the single phase, current monitoring type. Relays shall have adjustable, 1.0 to 5.0 amps, under current and over current ranges and shall operate on a 120 VAC source. Relays shall have an inherent 1.0 second delay, built in current transformer (CT), one set of Form C contacts each for under and over current rated 10 amps at 120 VAC, and shall automatically reset.

B. Load monitor relays shall be as manufactured by Diversified Electronics, Inc. No. CBA-102-ALE-5, or equal.

2.16 DC LOOP POWER SUPPLIES

A. Separately mounted dc power supplies shall be as manufactured by Acopian, or Power-One.

2.17 DC POWER SUPPLIES

A. Each instrumentation device requiring a DC power supply shall each be powered by a single 24 VDC minimum, regulated 120 VAC input type power supply. Each power supply may be integral to an indicator or controller in the loop or may be of the separately mounted type. In the case of several instruments in a common case or enclosure, a single DC power supply may be provided for all devices, providing that the distribution of DC power to each device is separately protected by fuse or circuit breaker.

B. Separately mounted dc power supplies shall be as manufactured by Acopian, or Power-One.

2.18 ELAPSED TIME METERS (ETM)

A. Elapsed time meters shall have a range of 0 to 99,999.9 hours and shall be non-reset type suitable for panel mounting, with gasketing as required to maintain panel integrity (NEMA 12 or 4, as required).

B. Elapsed time meters shall be as manufactured by General Electric Type 240, Simpson, or equal.

2.19 TOTALIZERS (QI)

A. Each totalizer shall be a high accuracy, 8-digit, non-reset, front panel mounted instrument with bezel. The input shall be a scaled 24 VDC pulse, with gasketing as required to maintain panel integrity (NEMA 12 or 4, as required).

B. The electric totalizers shall be as manufactured by Durant, KEP, or Sodecco.

2.20 PANEL HEATERS

A. Heaters shall be as manufactured by Hoffman Engineering, or equal. Heaters shall be provided complete with thermostat, ranged 40 to 100 degrees Fahrenheit.

B. Panel heaters and thermostats shall provide thermostatically controlled protection from low temperatures, and the effects of condensation inside control panels. Heaters shall be of the fan-forced type, to maintain stable temperatures throughout the enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.

D. See Section 26 05 53 - Electrical Identification for nameplate, circuit number marker, and wire marker, etc. requirements.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.03 MANUFACTURER’S FIELD SERVICES

A. Prepare and start systems under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings.

3.04 DEMONSTRATION

A. Demonstrate calibration and operation of devices.

B. Provide systems demonstration under provisions of Section 26 07 10 - Demonstration and Training.

C. After acceptance of the equipment, the Owner’s operators shall be provided with one-half day (minimum) of onsite training in the use and maintenance of the equipment. The training shall cover the calibration of the devices, preventative maintenance of all equipment, and troubleshooting and repair/replacement procedures.

3.05 SPARES

A. Spares for panel mounted components and devices shall be furnished as specified under Section 26 24 16 - Panelboards.

B. Turn over all spares at the time of, and as a condition of, acceptance.

END OF SECTION

SECTION 26 24 19
MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide modifications to existing motor control centers as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 53 - Electrical Identification

D. Section 26 24 16.13 - Panel Components and Devices

E. Section 26 07 05 - Electrical Testing and Equipment

F. Section 26 07 10 - Demonstration and Training

G. Section 26 08 00 - Calibration and Start-up of Systems

H. Section 26 28 13 - Fuses

1.03 REFERENCE STANDARDS

A. NECA 402 - Standard for Installing and Maintaining Motor Control Centers

B. NEMA AB 1 - Molded Case Circuit Breakers

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

D. NEMA ICS 2.3 - Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of MCCs Rated Not More Than 600 Volts

E. NFPA 70 - National Electric Code (NEC)

F. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type

G. UL 198E - Class R Fuses

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Shop Drawings: Include front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time/current curves of all equipment and components.

B. Wiring diagrams.

C. Test Reports: Indicate field test and inspection procedures and test results.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

E. The equipment shall not be released for manufacture prior to approval of and coordination with the Short Circuit, Flash Hazard, and Protective Devices Coordination Analyses.

F. Record Documents: Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

G. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 QUALITY CONTROL

A. Perform Work in accordance with NEMA ICS 2.3.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

B. Deliver in shipping splits, individually wrapped for protection, and mounted on shipping skids.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers.

1.09 SPARE PARTS

A. Furnish under provisions of Section 01 60 00 - Product Requirements.

B. Furnish one (1) set of replaceable contacts for each type of relay and each size of contactor or starter installed in motor control centers modified under this Contract.

C. Furnish three (3) push-to-test indicating light assemblies to match those installed in motor control centers modified under this Contract.

D. Furnish ten (10) indicating light lamps.

E. Furnish two (2) indicating light lenses of each color installed in motor control centers modified under this Contract.

F. Furnish one (1) control switch assembly of each type installed in motor control centers modified under this Contract.

G. For additional spare parts requirements, see Section 26 07 10 - Demonstration and Training.

PART 2 PRODUCTS

2.01 MODIFICATIONS TO EXISTING MOTOR CONTROL CENTERS

A. The existing motor control centers shall be modified by the addition of new devices and by wiring revisions as shown on the Drawings.

B. Starters for addition to existing motor control centers shall be of the magnetic type consisting of a circuit protective device in combination with a starter. The circuit protective device shall be a motor circuit protector type, molded case, air circuit breaker with interrupting capacity to match that of existing circuit breakers in the motor control center. The motor starter shall be comprised of NEMA size contactors; three pole, ambient compensating overload relays; interlocks; etc. The combination starters, Sizes 1, 2, and 3, shall be mounted on removable units designed to slide into the existing cubicles with stabs to engage the vertical bus and interlocks on the circuit protective device operating handle to prevent opening the unit door when the breaker is closed or in the “On” position. Individual 120 volt control circuit transformers with fused primary and with fused and grounded secondary shall be provided in each unit. Starters shall have a

spare auxiliary contact in addition to those indicated on the Drawings. Coils shall be rated for 120 volts, 60 Hertz operation. Additional control circuit transformer capacity shall be provided as required to safely carry all internal and external loads connected to it.

C. Replacement or added motor overload protection shall consist of a UL 508 solid-state overload relay for protection of the motors. The relay shall be Allen Bradley type E3 Plus. The overload relay shall be self-powered and provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA Size 1 through Size 7 motor starters.

D. Devices on the front of unit shall be mounted as part of the removable unit.

E. Nameplates shall be installed on the door of each unit and shall be attached by means of corrosion resistant screws. The plates shall be 1-1/4" high by 3-1/2" wide (minimum), white laminated plastic with engraved black letters. Letters shall be 1/8" high (minimum), block type. Nameplate engraving shall be as indicated in schedules on the Drawings, except nameplates for spare units shall be furnished blank. See the Drawings for nameplate details.

F. All equipment devices mounted within the units shall be identified as to function and schematic identification abbreviation. Identification plates shall be 1" by 3" engraved white lamicoid with black letters, attached with corrosion resistant screws.

G. Circuit protective devices shall be provided in accordance with the Short Circuit and Protective Devices Coordination Analyses specified under Section26 07 05 - Electrical Testing and Equipment.

H. Added control devices shall be as specified in Section 26 09 00 - Instrumentation and Control for Electrical Systems - General.

I. Branch feeder protection shall be thermal magnetic, molded case, circuit breakers of frame and ratings sizes as indicated on the Drawings and with interrupting capacity to match that of existing circuit breakers in the motor control center. Circuit breakers shall have auxiliary normally open and normally closed contacts and Devicenet System Accessory for connection to the MCC PLC.

J. The number and size of starters, contactors, and branch feeder circuit breakers added to each motor control center shall be as indicated on the Drawings and shall fit into the space shown.

K. Each added or modified starter, contactor, and/or circuit breaker shall have a reduced size, approved, "as-built," schematic wiring diagram, in ladder diagram format, inside each unit, indicating all internal components and wiring terminal strip connections, all 480 volt power wiring, all 120 volt control and power wiring, all instrument wiring, and all external components and wiring (shown dotted). Wiring diagrams shall have a plasticized coating to protect them from dirt, heat, and normal wear and tear.

L. Terminal blocks shall be installed, where required, to provide terminal block connections for all wiring to devices external to the motor control centers. All power feeder terminals or lugs shall be 75°C rated for copper conductors. Terminal blocks for control and alarm connections shall match the existing terminal blocks or shall be Allen-Bradley Types CA-1, CA-3, or CD-8; Square D Co.; or equal.

M. Wire for control and alarm wiring revisions within the motor control centers shall be No. 14 AWG minimum, Type MTW, 60°C. All wiring installed within a motor control center, which is powered from sources external to the MCC, shall be color coded yellow.

N. Door mounted control devices shall be furnished with anti-rotation keyways or other device to prevent slewing after mounting. Existing motor control centers are Allen-Bradley IntelliCENTER - Centerline Bulletin 2100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions under the provisions of Section 01 60 00 - Product Requirements.

B. Verify that area is suitable for motor control center installation.

3.02 INSTALLATION

A. Install motor control center components in accordance with manufacturer's instructions and per NECA 402-2014 Standards.

B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.

C. Install fuses in fusible switches.

D. Select and install heater elements or set solid state overload relays in motor starters to match installed motor characteristics. Contractor shall assume full responsibility for the selection and installation of the proper rating of thermal heater elements or the settings on solid state overload relays in all motor starters to which Contractor makes the feeder connections and/or completely wires.

E. Provide labels and engraved plastic nameplates under the provisions of Section 26 05 53 - Electrical Identification.

F. Motor Data: Provide neatly typed label inside each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

G. Arc flash and shock hazard warning labels shall be provided on an upper door of each vertical section and shall be marked as specified in Section 26 05 53 - Electrical Identification.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 01 45 00 - Quality Control and Section 26 07 05 - Electrical Testing and Equipment.

B. Inspect and test each added or modified controller to NEMA ICS 2.

END OF SECTION

SECTION 26 27 16
CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide the following items, as shown on the Drawings, specified or required:

1. Cabinets.
2. Terminal boxes.
3. Accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 33.16 - Boxes for Electrical Systems

D. Section 26 05 33.23 - Surface Raceways for Electrical Systems

E. Section 26 05 53 - Electrical Identification

1.03 REFERENCE STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

B. NEMA ICS 4 - Application Guideline for Terminal Blocks

C. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's standard data for enclosures and cabinets.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

C. Certified shop drawings and diagrams shall be furnished and delivered for approval as follows:

1. General dimensions and outline drawings showing the principal dimensions of the equipment and the location and size of electrical conduit connections.
2. Detailed drawings, descriptive data, and other data sheets showing design information which verified that the equipment meets the technical requirements of the Specifications.

1.06 QUALITY CONTROL

A. Perform Work in accordance with NEMA ICS 2.3.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

1.08 SPARE PARTS

A. Furnish under provisions of Section 01 60 00 - Product Requirements.

B. Provide three (3) of each cabinet key.

PART 2 PRODUCTS

2.01 CABINETS AND HINGED COVER ENCLOSURES

A. Manufacturers: Manufacturers and model numbers of cabinets, enclosures, and associated components shall be as follows:

1. Cabinets and Enclosures: Hoffman Engineering Co., Saginaw Controls, Stahlin, or Hammond.
2. Anti-condensation Heaters: Saginaw Control & Engineering No. SCE-AHC50 or equal.
3. Terminal Blocks: Allen-Bradley No. 1492-CA1, CA3, or -CD8.
4. Substitutions: Items of equal function and performance are acceptable, if in conformance with all sections of this Specification.

B. Cabinets and enclosures in dry locations shall be dust and oil tight, rated NEMA Type 12, and of 14 gauge (minimum) painted sheet steel construction or comparable non-metallic.

C. Cabinets and enclosures in wet locations shall be watertight, rated NEMA Type 4, and of 14 gauge (minimum) painted sheet steel construction or comparable non-metallic.

D. Cabinets and enclosures in corrosive areas shall be water, dust, and sleet tight, rated NEMA Type 4X, and of stainless steel construction or comparable non-metallic.

E. Doors shall be equipped with a padlockable latch or padlock hasp and shall be provided with one (1) padlock with three keys.

F. The top, sides, and doors of outdoor cabinets and enclosures shall be insulated with a 2-inch thick layer of extruded polystyrene material.

G. The doors shall be gasketed.

H. Provide an internal, mild steel sub-plate for mounting of internal components.

I. Provide and install two (2) minimum, 120 volt, anti-condensation heaters within each outdoor cabinet or enclosures. The heaters shall be of the self-limiting type, 50 watts, 120 VAC.

J. Cabinets and enclosures shall be provided with full-length door hinges. Hinges shall be stainless steel and the doors shall have a one point latch.

K. Interior cabinet or enclosure surfaces, except fittings, shall be painted with two coats of primer and two coats of white, high gloss, baked epoxy enamel paint. The exterior shall be painted with one coat of primer, two coats of ANSI 61 gray paint, and a final coat of clear polyurethane.

L. Terminal blocks shall be provided for all wiring entering cabinets and enclosures from external devices. Provide 10 percent spare terminals in addition to those required.

M. Terminal boxes shall be similar to cabinets and enclosures, except they shall have screw covers in lieu of hinged and latched doors.

2.02 EXPLOSION PROOF CABINETS, ENCLOSURES, AND TERMINAL BOXES

A. Explosion proof cabinets, enclosures, and terminal boxes shall be cast iron or cast aluminum with external mounting ears for surface mounting, internal mounting plate, hinged cover with stainless steel bolts and NEMA Type 4 seal, explosion proof, Class I, Division 1, Group D with bossed, drilled, and tapped conduit entrances as required for conduit and fitting connections as indicated on the Drawings. Explosion proof boxes shall be factory or field coated with a corrosion resistant, epoxy paint.

B. Terminal blocks for power conductor connections shall be power distribution blocks for connection of copper wire with individual, set screw type connectors for each terminated conductor, Gould Shawmut 66000 Series, Marathon 143 Series, or equal. Terminal blocks for

control conductor connections shall be of the screw terminal type, number of blocks as required, Allen-Bradley No. 1492-CA1 with associated mounting devices, Square D, or equal.

C. Provide an insulating barrier between the power and the control terminations.

D. Explosion proof terminal boxes shall be Hope Electrical Products Co. H6000 Type, Crouse-Hinds Style C Series EJB, or equal.

2.03 TERMINAL BOXES

A. Explosion proof terminal boxes for connection of the submersible dewatering and sample pump motor cable(s) shall be provided where shown on the Drawings. The terminal box shall be 12" high by 18" wide by 8" deep minimum with internal mounting plate for terminal blocks, cast iron or cast aluminum with external mounting ears for surface mounting, hinged cover with stainless steel bolts and NEMA Type 4 seal, explosion proof, Class I, Division 1, Group D with bossed, drilled, and tapped conduit entrances as required for conduit and fitting connections as indicated on the Drawings. Explosion proof terminal boxes shall be factory or field coated with a corrosion resistant, epoxy paint.

B. Terminal blocks for power conductor connections shall be power distribution blocks for connection of copper wire with individual, set screw type connectors for each terminated conductor, Gould Shawmut 66000 Series, Marathon 143 Series, or equal. Terminal blocks for control conductor connections shall be of the screw terminal type, number of blocks as required, Allen-Bradley No. 1492-CA1 with associated mounting devices, Square D, or equal. Control terminal blocks and conductors shall be coated with a conformal coating compound after permanent terminations have been completed. Conformal coating compound shall be Chemtronics Konform, GC Electronics Conkoat, or equal. Provide an engraved, laminated plastic instruction plate, adjacent to the control terminal block, engraved: "RECOAT CONTROL TERMINATIONS WITH CONFORMAL COATING COMPOUND AFTER EACH RETERMINATION OF CONDUCTORS TO PREVENT NUISANCE MOTOR LEAK ALARMS".

C. Provide an insulating barrier between the power and the control terminations.

D. Explosion proof terminal boxes shall be Hope Electrical Products Co. H6000 Type, Crouse-Hinds Style C No. EJB181208-N4-MP-S598-S391, or equal.

2.04 ENCLOSURE ACCESSORIES

A. Hardware on the exterior of NEMA Type 4 and NEMA Type 4X enclosures, including hinge pins, screws, bolts, nuts, washers, etc., shall be made of 300 series stainless steel.

B. Combination drain and breather shall be Crouse-Hinds ECD Combination Series, Appleton, or equal. Combination drain and breather shall be Stahlin Drain Vent or equal on NEMA Type 4X enclosures.

C. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID “A Special”, or equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions under the provisions of Section 01 60 00 - Product Requirements.

B. Verify that surfaces are ready to receive work.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

C. Install cabinet fronts plumb.

D. All equipment installed in hazardous areas shall be provided in explosion proof enclosures, except equipment listed as intrinsically safe may be provided in NEMA Type 4 or non-metallic NEMA Type 4X enclosures. All explosion proof enclosures shall be factory or field coated with a corrosion resistant finish.

E. NEMA Type 4 and Type 4X enclosures in other than corrosive areas shall be equipped with a combination drain and breather. The drain shall be mounted on a bolt-on, gasketed hub.

F. All internal cabinet and enclosure components shall be mounted on the sub-plate positioned for easy access, convenient wiring, and for easy removal.

G. Convenience receptacle mounted within cabinets and enclosures shall be mounted in a handy box with a cover plate.

H. See Section 26 05 33.23 - Surface Raceways for Electrical Systems for conduit entrance to cabinets and enclosures requirements.

I. Mark or label all boxes, cabinets, and enclosures as specified in Section 26 05 53 - Electrical Identification.

J. The threads of all corrosive area, hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, cable fittings, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

K. Cabinets and enclosures shall be mounted to walls, columns, machine frames, etc., with 1/2" separation from same, and all necessary spacers, brackets, structural pieces, inserts, anchors, and bolts shall be provided.

L. Termination of the submersible dewatering and sample pump motor cable(s) at the terminal box shall incorporate a cord connector, a sealing fitting, and an explosion proof union fitting for each cable. The end of the cable's overall jacket shall be potted within the seal-off fitting in accordance with Article 501.5(D) of the National Electrical Code. The cable's overall jacket shall be stripped back to provide sufficient lengths of individual conductors for proper termination within the terminal box.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide the following items, as shown on the Drawings, specified or required:

1. Wall switches.
2. Receptacles.
3. Device plates and box covers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 33.16 - Boxes for Electrical Systems

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction

B. NEMA WD 1 - General Color Requirements for Wiring Devices

C. NEMA WD 6 - Wiring Devices - Dimensional Specifications

D. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, materials, finishes, and configurations.

B. Submit manufacturer's installation instructions.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 WALL SWITCHES

A. Switches for local control of 120-volt lighting shall be quiet, quick make, slow break design with totally enclosed case, flush type, single pole, toggle switches, 20 ampere capacity at 120/277 volts. Switches shall be UL listed and shall meet NEMA WD 1.

B. Two pole, 3-way, 4-way, and key switches shall have similar ratings.

C. Where pilot lights are indicated, provide switches as specified above plus a separate pilot receptacle with plate and bull's eye in a two gang box.

D. Lighting switches shall be Hubbell Series HBL1220, Leviton Series 1220, General Electric GE5951, Cooper Wiring Devices, or equal.

E. Lighting switches installed in corrosive areas shall consist of switches as specified above installed in non-metallic corrosion resistant, FD type boxes with weatherproof, corrosion

resistant, flexible silicone rubber, bubble type covers; Hubbell No. HBL1795, Pass & Seymour No. 4517, or equal.

2.02 RECEPTACLES

A. Duplex receptacles shall be 20-amp, 125-volt, 3 wire, grounding type, Hubbell Cat. No. HBL5362, General Electric GE5362, Cooper Wiring Devices No.5362B, or equal. Covers for general use receptacles shall be Crouse-Hinds Co. No. DS23G, Leviton 5362, Appleton Electric Co., or equal.

B. Duplex receptacles installed in corrosive areas shall consist of a 20-amp, 125-volt, 3 wire, grounding type, corrosion resistant receptacle; Hubbell Cat. No. HBL53CM62, Leviton 53CM-62, General Electric GE0526C, Cooper Wiring Devices No. 5362CRY, or equal mounted in a non-metallic, corrosion resistant box with a corrosion resistant, weatherproof cover; Carlon, TayMac Corp., or equal.

C. G.F.C.I. duplex receptacles shall be 20-amp, 125-volt, 3 wire, ground fault circuit interrupter type receptacles with face mounted "test" and "reset" pushbuttons and matching stainless steel cover plate. G.F.C.I. receptacles shall be Hubbell Cat. No. HBL GF-5362-I, Leviton 6898-I, General Electric GFR5362, Cooper Wiring Devices, or equal.

2.03 WALL AND COVER PLATES

A. Where switches and receptacles are installed in concealed boxes, they shall be provided with Type 302 stainless steel cover plates.

B. Where switches are installed surface mounted, they shall be installed in Type FD boxes with mounting lugs and provided with surface mounting covers. Covers shall be weatherproof where required, Crouse-Hinds No. DS181 or equal.

C. Weatherproof receptacle covers shall be raintight while in use, NEMA Type 3R rated, UL listed and marked for use in Wet Locations with plug-cap inserted, and shall be made of impact resistant, ultraviolet inhibiting polycarbonate; TayMac Corp. with deep cover, Thomas & Betts WT Series with deep lid, Intermatic Flexi-Guard Series, Carlon E9U In-Use Series, or equal.

D. Weatherproof covers for single receptacles shall be UL listed and marked for use in Wet Locations, gasketed, cast alloy with spring closed door, Hubbell No. HBL7420, Cooper Wiring Devices, or equal.

E. Padlockable cover plates for switches and/or receptacles shall be weatherproof, die-cast aluminum with gasket, Killark WCV Series or equal.

F. For general use switches located in areas designated hazardous, boxes and covers shall be explosion-proof, single gang with rocker arm type operating handles. Covers and boxes shall be catalog No. EFD-175-NL-Q and No. EFK-R12-Q as manufactured by Appleton Electric Co., Crouse-Hinds, or equal.

2.04 MISCELLANEOUS

A. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID “A Special”, or equal.

B. Metallic, except stainless steel, device boxes, outlet boxes, cover plates, fittings, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum 0.040-inch (40 mil) thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify conditions under the provisions of Section 01 60 00 - Product Requirements.

B. Verify that outlet boxes are installed at proper height.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 INSTALLATION

A. Install in accordance with NECA 1.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Where more than one switch occurs in the same location, they shall be installed in gang type boxes.

G. Duplex receptacles, shown on the Drawings outdoors or below grade, shall be mounted in weatherproof boxes and cover plates. Boxes shall be rust proof, cast metal having threaded openings for conduit connections and shall be mounted horizontally on or in the wall.

H. Receptacles in dry, indoor locations shall be installed in surface mounting, Type FD boxes with mounting lugs.

I. The threads of all hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, outlet box connections, wiring device boxes, cover plate screws, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

J. See Section 26 05 53 - Electrical Identification for nameplate, circuit number marker, wire marker, etc. requirements.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 - Boxes for Electrical Systems to obtain mounting heights specified or indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Inspect Each Wiring Device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Refer to Section 01 77 00 - Closeout Procedures with regard to cleaning installed work.

B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide fuses as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09 96 00 - Industrial Paints and Coatings

B. Section 26 05 00 - Common Work Results for Electrical

C. Section 26 05 10 - Basic Electrical Materials and Methods

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses

B. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Product Data: Provide data sheets showing electrical characteristics including time-current curves and fuse let-through values for fault current available.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 FUSES

A. Acceptable Manufacturers:

1. Bussmann
2. Mersen
3. Edison
4. Littelfuse

B. Requirements:

1. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
2. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
3. Fuses shall be dual element or current limiting type, Class R, or as otherwise required for installation in the equipment furnished, and as shown on the Drawings. Fuses shall provide type II protection for motor circuits.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fuses in accordance with manufacturer's instructions.

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

C. Fuse holders shall be provided with fuses.

D. Contractor shall replace all blown fuses and the quantities specified above shall be turned over to the Owner at the time of completion.

E. Spare fuses shall, be packed and boxed for storing with each box labeled with fuse rating, class, etc.

END OF SECTION

SECTION 26 28 16.13
CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide circuit breakers as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 53 - Electrical Identification

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction

B. NEMA AB 1 - Molded Case Circuit Breakers

C. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Shop Drawings: Indicate voltage, short circuit ampere rating, circuit breaker arrangements and sizes.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

C. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

D. Record Documents: Record actual locations of Products; indicate actual branch circuit arrangement.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

PART 2 PRODUCTS

2.01 CIRCUIT BREAKERS

A. Circuit breakers shall be of the bolt-in-place type using single pole or common trip, two or three pole as indicated on the Drawings. Circuit breakers shall be of the molded case type with thermal magnetic trip and breaker handles indicating "on" - "off" and "trip" positions. Ground fault circuit interrupter (GFCI) type breakers shall be provided where indicated on the Drawings. Breakers shall have 22,000 ampere interrupting capacity minimum and shall be

approved for “switching duty”. Circuit breakers shall be Eaton-Cutler-Hammer, Square D by Schneider Electric, or ABB.

B. Enclosures for individually mounted circuit breakers shall be similar to those for disconnect switches as specified in Section 16441, including padlockable operating handle.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install circuit breakers in accordance with manufacturer’s instructions.

B. Circuit breakers shall have a circuit number marker or equipment designation nameplate on or adjacent to the breaker.

C. See Section 26 05 53 - Electrical Identification for nameplate, circuit number marker, labeling, etc. requirements.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Arrange circuits on the transformer secondary to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

END OF SECTION

SECTION 26 28 16.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals to provide non-fusible disconnect switches as shown on the Drawings, specified or required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

C. Section 26 05 26 - Grounding and Bonding

D. Section 26 05 29 - Hangers and Supports for Electrical Systems

E. Section 26 05 33.16 - Boxes for Electrical Systems

F. Section 26 05 53 - Electrical Identification

G. Section 26 28 13 - Fuses

1.03 REFERENCE STANDARDS

A. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum)

B. NFPA 70 - National Electric Code (NEC)

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.05 SUBMITTALS

A. Product Data: Provide switch ratings and enclosure dimensions.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 - Product Requirements.

PART 2 PRODUCTS

2.01 DISCONNECT SWITCHES

A. 600 volt rated, explosion proof disconnect switches shall be Eaton Crouse-Hinds, Emerson Appleton Electric Co. Type EDS, or Hubbell-Killark.

B. Auxiliary interlocks shall be provided where shown on the Drawings.

C. Disconnect switches shall have provisions for padlocking in either the "On" or "Off" positions and all terminals or lugs shall be 75°C rated for copper conductors. Fused switches shall utilize Class R fuses.

D. Enclosures shall be NEMA 4X stainless steel, or explosion proof, as indicated on the Drawings.

E. Combination drain and breather shall be Crouse-Hinds ECD Combination Series, Appleton, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install disconnect switches where indicated.

B. Install fuses in fusible disconnect switches.

C. Provide heavy duty, 3 pole, 600 volt, non-fused or fused disconnect switches through 100 amperes at locations indicated or as required.

D. NEMA 4X enclosures in other than corrosive areas shall be equipped with a combination drain and breather. The drain shall be mounted on a bolt-on, gasketed hub.

E. See Section 26 05 53 - Electrical Identification for nameplate, circuit number marker, labeling, etc. requirements.

F. Arc-flash and shock hazard warning labels shall be provided on the door of each switch enclosure and shall be marked as specified in Section 26 05 53 - Electrical Identification.

END OF SECTION

SECTION 31 10 00
SITE PREPARATION

GENERAL

1.01 SCOPE OF WORK

A. Section includes:

1. Protection of existing fences, infrastructure, and associated improvements, streets and utilities within and near construction areas from damage due to boulders, trees, or other objects dislodged during the construction process.

2. Labor, equipment, and materials necessary for existing tree relocation, protection and trimming.

3. Providing temporary stabilized crushed rock for staging/laydown in accordance with the Contract Documents.

4. All clearing and grubbing work indicated on the Drawings and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, and disposal of materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 32 13 - Construction and Schedule Constraints

B. Section 01 33 00 - Submittal Procedures

C. Section 01 57 13 - Temporary Erosion and Sediment Control

1.03 REFERENCE STANDARDS

A. Code of Standards of the American Association of Nurserymen and the American Standard for Nursery Stock and Tree Care Association Standards for Pruning and Guying of Shade Trees.

1.04 DEFINITIONS

A. AASHTO: American Association of State Highway and Transportation Officials

1.05 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. Name and location of plant providing aggregate.

C. Type and composition of proposed materials, including aggregate gradation.

D. Certificates of Compliance certifying compliance with the referenced specifications and standards.

E. Submit documentation, if applicable, of permission from property owners, of any timber removal or salvaged timber with work occurring outside of property or right-of-way limits.

F. Chain Link Protection Fencing: Submit proposed methods and sequence of site preparation to the Owner for review prior to start of Work.

G. Copy of Arborist's certification.

PRODUCTS

2.01 MATERIALS

A. Aggregate for Stabilized Staging/Laydown:

1. Aggregate stabilized staging/laydown area base shall be in conformance with Item 304 of the referenced ODOT specifications and AASHTO No. 1, 2, and 57 stone/rock as referenced on the Drawings.

EXECUTION

3.01 INSTALLATION

A. General:

1. Contractor is responsible to provide equipment, workmanship, and materials required to achieve a finished product which meets these specifications for the stabilized staging/laydown area.
2. Do not place aggregates on frozen subgrade or when air temperature is below 35°F.
3. Do not place aggregate materials when natural light is not sufficient to properly observe work on operations.
4. Do not place paving and surfacing material before subgrade is reviewed and accepted by the Owner. Do not place paving and surfacing materials on a frozen or muddy subgrade.
5. Provide adequate drainage at all times to prevent water from standing on subgrade.

B. Cleaning:

C. Clean Site of rubbish, excess material, structures, and equipment. Restore damaged property.

D. Over-excavation, Regrading, and Backfill Under Fill Areas:

1. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require over-excavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The over-excavated volumes to a level of 1-foot below the existing ground contours shall be backfilled.

E. Soil Erosion and Sedimentation Control:

1. Contractor, at Contractor's expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Drawings or as determined by Owner.
2. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in waterways downstream of the Work.
3. The measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.
4. Comply with requirements of Section 01 57 13 - Temporary Erosion and Sediment Control.

F. Seasonal Constraints:

1. No tree or shrub removal can take place between the dates listed in Section 01 32 13 - Construction and Schedule Constraints, unless coordination and approval is given through by the Owner.

G. Clearing:

1. Trees, stumps, brush, hedges, and other vegetation occurring within the Contract limits, as defined on the Drawings or as directed by Owner, shall be cut off flush with the ground and shall be completely removed.
2. Use every precaution to prevent damage to and provide protection as necessary of existing plant material. Repair or replace to original condition, as acceptable to the Owner and at no additional cost to the Owner, any material or Work damaged or destroyed while performing Work.

3. Vegetation protection fencing shown on Drawings are minimum required for Work. Contractor shall be responsible for providing additional temporary fencing during the Work as necessary to protect vegetation.

4. Flagging of Existing Trees: Flag trees to remain and to be removed with a bright and different colored ribbon. Notify the Owner at least 48 hours prior to commencing of Work to verify all trees that are flagged.

5. Do not park any vehicles or equipment, nor store any materials or stockpiled soil, nor dispose of building materials, chemicals, petroleum products or other detrimental substances within drip line of tree. Protect trees from flame, smoke and heat. Construction access to Site shall not occur beneath drip line of trees.

H. Clearing and Grubbing:

1. Trees, stumps, brush, shrubs, hedges, roots, corduroy, logs, matted roots, other vegetation and debris occurring within the Contract limits as defined on the Drawings or as directed by Owner, shall be completely removed. Depth of removal shall be in accordance with paragraphs 3.01.H thru 3.01.L of this Section.

I. Selective Clearing:

1. Selective clearing shall consist of removing and disposing of dead, diseased, poorly formed, or otherwise undesirable trees, undergrowth, stumps, uprooted trees and debris. The trees to be removed will be marked and the area where the undergrowth is to be removed will be indicated on the Drawings or designated by Owner.

2. Selective Clearing, Type I:

a. Trees and stumps shall be cut off at an elevation not more than four (4) inches (100 mm) above the existing ground level.

3. Selective Clearing, Type II:

a. Trees and stumps shall be chipped or ground down to an elevation approximately four (4) inches (100 mm) below proposed ground level.

J. Depth of Removal in Excavation Area:

1. For excavation areas within roadways, parking lots, and other paved areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the subgrade elevation.

2. In all other excavation areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the finish surface elevation, or as indicated on the Drawings or as designated by Owner.

K. Depth of Removal in Embankment Areas:

1. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is five (5) feet (1.5 m) or less in height above the existing ground, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the existing ground.

2. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is more than five (5) feet (1.5 m) in height above existing ground, the trees and stumps shall be cut off flush with the existing ground surface.

3. For embankment areas other than roadways, parking lots, and other paved areas, the trees and stumps shall be cut off flush with the existing ground surface, or as indicated on the Drawings or as designated by Owner.

L. Removal of Trees, Stumps, and Other Vegetation:

1. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections.

2. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of Owner.

M. Removing Corduroy:

1. Logs, stumps, poles, brush, and other unsatisfactory material occurring in the Contract limits at or below the surface of the ground and within the depth of four (4) feet (1.2 m) below the proposed plan grade shall be removed and shall be disposed of by Contractor.

2. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Drawings or as determined by Owner. Trees and stumps buried in these areas shall have a minimum cover of two (2) feet (0.6 m).

N. Holes and Trenches:

O. Holes and trenches remaining after the clearing or grubbing operations in embankment areas, shall have the sides broken down or leveled, and shall be refilled with acceptable material.

a. The material shall be moistened and properly compacted in layers by tampers or rollers to the density required under roadways, parking areas, and other special areas, as determined by Owner.

b. The same construction procedure shall be applied to all holes and trenches remaining in excavation areas where the depth of holes exceeds the depth of proposed excavation.

P. Salvaging Timber:

1. Trees required to be removed and having a diameter of four (4) inches (100 mm), or more, are classed as merchantable timber. On right of way, fee simple, merchantable timber shall become the property of Contractor, unless otherwise specified in the Contract Documents. When such material is placed outside of the right of way, Contractor shall obtain and provide Owner with written permission from Owner of the property on which the timber is to be placed.

2. Merchantable timber to be removed from areas outside of right-of-way, fee simple, shall be cut and piled for the use of property owner, except where Contractor provides Owner with a written agreement from property owner that he does not desire the salvaged timber. Where property owner has signed such an agreement, the salvaged timber will become the property of Contractor.

3. When such material is placed outside the Work limits, Contractor shall obtain and provide Owner with written permission from the of the property on which the timber is to be placed. Timber from 4 to 12 inches (100 to 300 mm) in diameter may be left in full tree lengths or cut to commercial lengths, at the option of the Contractor. Timber 12 inches (300 mm), or more, in diameter shall be cut into commercial lengths and piled separately from other timber.

Q. Existing Trees to Remain:

1. General:

a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems.

b. Individual trees and areas shown to remain shall be protected by six (6) foot high chain link fence. Install fencing before site preparation, grading, and clearing and grubbing operations.

c. Under no circumstances shall the Contractor remove existing trees designated to remain for his/her convenience or ease of construction.

d. Trees which are not to be removed and become damaged or die shall be replaced with trees of the same species and equal size.

e. Prior to installation, stake the location of protection fencing for approval by the Owner. Location stakes or marking shall be placed not greater than ten (10) feet on center.

2. Excavation Around Trees:

a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems. Excavate within drip line of trees only where shown on the Drawings.

b. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots. Contractor shall notify the Owner prior to cutting roots over 6 inches in diameter. Roots up to and including 3/4-inch diameter shall be cut by hand saws. Do not leave roots exposed to sun or drying for more than 24 hours. Protect all exposed roots with moist organic mulch or burlap and backfill as soon as possible.

c. Where excavating for new construction is required within drip line of tree, excavate by hand to minimize damage to roots and perform as follows:

1) Use narrow tine spading forks and comb soil to expose roots.

2) If main lateral roots are immediately adjacent to location of new construction, cut roots three (3) inches from new construction.

3) Do not allow exposed roots to dry out before permanent backfill is placed.

4) Provide temporary earth cover, or pack with peat moss and wrap with burlap.

5) Water and maintain in moist conditions until covered with backfill.

R. Trimming of Existing Trees:

1. General:

a. Tree pruning, tree repair, and tree removal shall be performed by competent workers, under the supervision of an arborist holding certification from the International Society of Arboriculture (ISA) or equivalent education and experience. No pruning shall be performed, unless approved by the Owner.

b. Coordinate with City of Cleveland Arborist when trimming or removing within public right of way to obtain approval.

2. Pruning:

a. Cut branches with sharp pruning instruments and do not break or chop.

b. Prune flush with trunk surface.

3. Trimming:

a. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch.

b. Spikes shall not be used for climbing live trees.

c. Cuts over 1-1/2-inches in diameter shall be coated with an asphaltic emulsion material.

END OF SECTION

SECTION 31 22 00
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 22 00 - Unit Prices

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 23 13 - Subgrade Preparation

F. Section 31 23 16 - Structural Excavation and Backfill

G. Section 32 92 19 - Seeding

1.03 SOIL EROSION AND SEDIMENTATION CONTROL

A. Contractor, at Contractor's 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 the 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 57 13.

1.04 REFERENCE STANDARDS

A. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

B. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition.

PART 2 PRODUCTS

2.01 GRANULAR MATERIAL

A. Class II granular material meeting the requirements of MDOT Section 902.

2.02 AGGREGATE BASE COURSE

A. 21AA dense graded aggregate conforming to MDOT Section 902.

PART 3 EXECUTION

3.01 SITE GRADING

A. Sites shall be graded as specified on the Plans or as determined by the 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 the 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. The 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.

B. 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.

C. If there is insufficient working area, the topsoil may be removed, stockpiled and later replaced on the original lot or parcel. Contractor shall furnish the 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.

D. 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 the Engineer will be disposed of by the Contractor at Contractor's expense.

E. Before removing topsoil, vegetation shall be reduced to a height of approximately 4 inches 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.

F. Equipment and methods of operations shall be such as to avoid the lifting of the subsoil. If soil or weather conditions are unsuitable, the Contractor shall cease stripping until stripping can resumed in a suitable manner.

G. 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 the Engineer.

H. 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 the Contractor.

I. 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.

J. Contractor shall not place topsoil around trunks and root areas of trees to be preserved.

K. 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.

L. Topsoil stockpiles shall be located as near the original location as possible and no payment will be made for overhaul.

M. 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 ON-SITE

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 the 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. The site shall be graded as necessary to comply with the Plans or as determined by the 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 89 00.

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% optimum moisture when placed. Fill shall be compacted to a density not less than 95% of the maximum unit weight and placed in layers no less than 9 inches and no greater than 15 inches. 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.

F. No frozen material will be allowed in the fill area or in the embankment being constructed.

1. Frozen material on a partially completed fill shall be removed before placing any additional fill. Frozen material shall be stockpiled outside the grading limits until thawed.

2. Thawed material from the stockpiled frozen material may be used in the fill and embankment areas.

3.05 FINISH GRADING

A. Subgrade shall be smoothed parallel to proposed finished grades and elevations specified on the Plans. Subgrade shall be scarified to assure bond with the topsoil prior to spreading of the topsoil.

B. Topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans or acceptable to the Engineer. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than 0.1 foot from the elevations indicated on the Plans.

C. Finished grading shall be done when the ground is frost-free and weather is favorable.

3.06 ADJUST STRUCTURES

A. Structures to be adjusted shall be as called for on the Plans or as indicated by the Engineer. Adjustment of structures shall apply where the elevation of the casting is either raised 12 inches or less or lowered 6 inches or less.

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.

a. For structures in concrete pavement, the structure shall be adjusted, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.

1) In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

2) 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. The concrete pavement, minimum 8 inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

b. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed. The structure shall be adjusted, backfilled and compacted as noted below.

1) Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement. 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.

2) 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. The 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. The structure shall be adjusted, backfilled and compacted as noted below.

4. Six inches of aggregate base course, unless otherwise noted on the Plans, shall be placed below the proposed pavement. 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.

5. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

D. 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.

E. 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.

F. 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.

G. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by the Engineer.

H. The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch thick.

I. The structure shall be properly backfilled with Granular Material compacted in place and meeting the approval of the Engineer.

J. The flow in the entire system shall be maintained, at the 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 the Contractor's expense.

3.07 RECONSTRUCT STRUCTURES

A. Structures to be reconstructed shall be as called for on the Plans or as determined by the Engineer. Reconstruction of structures shall apply where the elevation of the casting must be

raised in excess of 12 inches, lowered in excess of 6 inches, 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.

a. For structures in concrete pavement, the 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 concrete pavement.

1) In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

2) 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. The concrete pavement, minimum8 inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

b. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.

1) The structure shall be reconstructed, backfilled and compacted as noted below.

2) Six inches of aggregate base course, unless otherwise noted on the Plans, shall be placed below the proposed pavement. 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.

3) The 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 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. The 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.

4. 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.

5. The bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the Project.

D. 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 Plans.

E. The 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.

F. 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 the Engineer.

G. The necessary brick work and precast concrete sections shall be installed to meet the design grade.

H. Manhole steps shall be furnished and shall be installed, as necessary, so that maximum spacing is 24 inches. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by the Engineer.

I. The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch thick. The structure shall be properly backfilled with granular material, compacted in place, and meeting the approval of the Engineer.

J. The flow in the entire system shall be maintained, at the Contractor's expense, while performing any part of the Work. The structure shall be cleaned and unsuitable material shall be disposed of at the Contractor's expense.

END OF SECTION

SECTION 31 23 13
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 22 00 - Unit Prices

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 22 00 - Grading

F. Section 31 23 19 - Dewatering

G. Section 32 92 19 - 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 D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
2. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity
3. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles
4. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile
5. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
6. ASTM D6241: Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe
7. American Association of State Highways and Transportation Officials
8. Michigan Department of Transportation (MDOT), 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 1 inch in 10 feet.

1.05 SUBMITTALS

A. Test Reports:

1. Testing lab shall provide the 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 the Engineer.

3. Testing lab shall provide the 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 square yard in area, and the manufacturer's certification that the proposed fabric meets or exceeds the requirements listed in Part 2 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. 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 the 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 areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

A. Granular Material shall conform to the requirements for Class II granular material as specified in MDOT Section 902.

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. 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/D4632M	270 lbs. (min)
Elongation	ASTM D4632/D4632M	15% (min)
Trapezoidal Tear	ASTM D4533/D4533M	100 lbs. (min)
CBR Puncture Strength	ASTM D6241	900 lbs. (min)
Apparent Opening Size	ASTM D4751	40 – 70 U.S. Sieve
Permittivity	ASTM D4491/D4491M	0.05 per sec (min)

2.04 SEPARATOR FABRIC

A. Furnish geotextiles of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Geotextile must have the minimum required strength values in the weakest primary direction. Contractor may use nonwoven geotextile that is one or a combination of the following:

1. Needle punched, heat bonded, or resin bonded.

B. Furnish a manufacturer's certified report of test or analysis that shows the geotextile delivered meets the requirements of this specification to the Engineer at least 15 days before use in the Work. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the Engineer.

C. If using sewn seams, furnish a field sewn seam sample produced from the geotextile and thread sewn with the equipment that will be used on the project, before incorporating into the work.

D. Furnish geotextile conforming to the following physical properties:

Test	Method	Value
Minimum grab tensile strength	ASTM D4632/D4632M	170 lb
Minimum puncture strength	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 70 sieve
Minimum permittivity	ASTM D4491/D4491M	0.35 s-1

1. Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

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 the Engineer. Removal or abandonment of structures shall be in accordance with Section 01 89 00.

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 the Engineer.

B. Material shall be compacted to 95% of its maximum unit weight.

C. The furnishing, placing and compacting of the backfill material shall be at the Contractor's expense.

3.03 SALVAGING AND STOCKPILING TOPSOIL

A. Topsoil, within the grading limits for cuts, and where the fill is less than 5 feet 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 Contractor's expense.

D. Removing and salvaging topsoil shall be in accordance with Section 31 22 00.

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 the Engineer.

B. Deposits of frost heave material within lines 2 feet outside the proposed roadbed shall be removed to a depth of 3 feet below the surface of the earth grade, unless otherwise shown on the Plans or as determined by the 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 the 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, removed and disposed.

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 2 feet 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 7 inches, by rolling with a roller weighing not less than 10 tons.

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 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 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 unsuitable material.

C. Large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation and debris occurring between lines 3 feet outside the grading limits or as otherwise shown on the Plans shall be completely removed and properly disposed of as specified in Section 31 11 00.

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 of right-of-way unless additional lengths are requested in writing and approved by the Engineer.

E. Excess excavated material shall be removed from the project by the Contractor along approved routes to disposal sites approved by the 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 89 00.

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 the Engineer and shall be secured by the 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 the Engineer. To facilitate the accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents, the Contractor shall perform all the regular excavation and grading with existing materials for any designated area and the Engineer will cross section these areas prior to the 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. Borrow material placed beyond the neat lines called for on the Plans or which is not authorized by the 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 the Contractor between the source of borrow and the Project shall be maintained by the Contractor, at Contractor's expense, including repairs of any damage caused by Contractor's operations. Also included is the application of a dust palliative when necessary, as determined by the Engineer.

3.08 EMBANKMENTS

A. Embankments shall be constructed with sound earth. The 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. The topsoil shall be stripped from the entire fill area. The depth of the topsoil to be removed shall be as shown on the Plans or as determined by the 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 9 inches.

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 3 inches in diameter be placed within 12 inches of the surface of the earth grade within the areas between lines 2 feet 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. The material shall be deposited and spread in layers not more than 12 inches depth, loose measure, parallel to the finished grade and extending to the full width of the embankment. The 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. The operation of compacting shall be continued until each layer is compacted to the required density for its full width.

2. Controlled Density Method:

    a. The material for the embankment shall be deposited and spread in layers not more than 9 inches 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 in thickness if the specified density is obtained.

b. The material for embankments of 5 feet or less and the bottom 4 feet of embankments of more than four 4 feet 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. The material for that part of the embankment more than 5 feet above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than 3% above optimum at the time of compaction, except that the moisture content of the top 3 feet of the embankment shall not exceed optimum.

F. If granular material is used to construct the embankment, it shall be at a moisture content below saturation.

G. If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.

H. 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.

I. 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 the 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. Any 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 the Contractor at Contractor's 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.

B. When proof rolling under structures, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.

C. Proof rolling shall be done in the presence of the Engineer. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by the Engineer, and replaced with the appropriate fill material.

D. 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 the Contractor as determined by the Engineer at no cost to the Owner. Notify the 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 the Engineer, below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be 5 feet or less in height to plan grade, or;

2. the removal of unsuitable soils below the subgrade elevation, as determined by the Engineer in cut areas after the subgrade has been established.

B. In fill areas, after topsoil has been stripped in accordance with this Section, the 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, the 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 non-frost heaving material similar to the adjacent soil. However, in areas as determined by the Engineer where free water due to seepage is present, the excavation shall be backfilled with MDOT Granular Material, Class II and drainage shall be provided. The 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. The 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 for each joint. Fabric shall be placed so that the upper strip will overlap the next lower strip.

C. 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 24 inches to adjacent undamaged geotextile in all directions.

3.13 GEOTEXTILE SEPARATOR FABRIC

A. Before placing the geotextile, smooth, shape, and compact the subgrade to the required grade, section, and density. After placing the geotextile on the subgrade, do not allow traffic or construction equipment to travel directly on the geotextile.

B. Roll the geotextile out on the roadway and pull taut manually to remove wrinkles. Join separate pieces of geotextile by overlapping or sewing. Place the geotextile in the overlapped joints so it overlaps at least 18 inches.

C. Engineer may require the use of weights or pins to prevent the wind from lifting the geotextile.

D. After placing, do not expose the geotextile longer than 48 hours before covering.

E. Place backfill material over the geotextile by back dumping with trucks and leveling with a crawler dozer. Do not use construction equipment that causes ruts deeper than 3 inches. Fill ruts with additional material. Do not smooth ruts without adding additional material. Cover damaged areas with a patch of geotextile using a 3 foot overlap in all directions.

3.14 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 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. Where a subbase or base course is not required, the subgrade shall be trimmed to the established grade within ± 3/4 inch.

C. The 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 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 above or below the established grade measured at right angles to the slope.

b. Class B fill slopes shall be finished to within 0.2 foot of the established grade and cross section from the outside shoulder line for a distance of 3 feet down the slope. The remainder of the completed fill slope shall conform to the requirements for Class B backslopes.

3. 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.

4. Debris except sod, leaf mold and rotted forest litter shall be removed and loose clods of earth extending beyond the slope tolerance specified shall be broken or removed.

5. Where waste earth or other surplus material is deposited on fill slopes, the slopes may be flattened or otherwise altered as directed by the 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 the 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.

3.15 SUBBASE

A. Granular material for subbase shall be evenly spread and compacted as specified in MDOT Section 301.

B. The thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches in depth, loose measure.

C. The 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 such 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. The subgrade shall be corrected and new subbase material placed and compacted. This Work shall be considered incidental to the construction of the Project.

3.16 SCARIFY, RE-GRADE AND COMPACT EXISTING SUBGRADE

A. The existing subgrade (base) shall be scarified to a depth of 9 inches within the limits as shown on the plans. The subgrade shall then be re-shaped to the cross section as shown on the plans

and compacted to 95% of its maximum unit weight by rolling with a roller weighing not less than 10 tons.

3.17 ROADWAY DITCHING

A. Ditching shall be constructed at the locations called for on the Plans or as determined by the Engineer. The ditch may be shaped by machine grading or another method approved by the Engineer to achieve the cross section, line and grade shown on the Plans.

B. The excess material from the ditch construction shall be disposed of by the Contractor at Contractor's expense.

C. The ditch section shall be graded to receive topsoil and seed.

1. Topsoil, seed, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19.

D. Contractor, at Contractor's 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.

3.18 RIGHT-OF-WAY RESTORATION

A. The right-of-way shall be restored in accordance with the type and location specified on the Plans. The right-of-way may be shaped by machine grading or another method approved by the 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 Contractor's expense, as specified in Section 01 89 00.

C. The right-of-way shall be graded to receive topsoil and seed.

1. Topsoil, seed, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19.

D. Contractor, at Contractor's expense, shall furnish, place, and compact any additional fill, meeting the approval of the Engineer, needed to construct the right-of-way to the cross sections called for on the Plans.

3.19 MACHINE GRADING

A. The 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 Contract Documents.

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 the Engineer.

D. The 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.

3.20 MAINTENANCE AGGREGATE

A. Contractor shall furnish and install MDOT 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 the Engineer.

B. Maintenance aggregate will be incidental to the Project unless otherwise specified in the Contract Documents.

3.21 TESTING

A. During the course of the Work, the 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 the Owner and approved by the Engineer.

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 sieve.

3.22 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 the Engineer.

B. Any extra testing or sampling required by the Engineer, because of deficiencies, shall be at the Contractor's expense.

END OF SECTION

SECTION 31 23 16
STRUCTURAL EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes excavation for structures, removal and disposal of excavated materials, backfilling, backfill materials and compaction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 57 13 - Temporary Erosion and Sediment Control

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 22 00 - Grading

E. Section 31 23 19 - Dewatering

F. Section 32 92 19 - 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 D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

2. American Association of State Highway Transportation Officials

3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 SUBMITTALS

A. The testing laboratory shall provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill. The testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.05 SOIL EROSION AND SEDIMENTATION CONTROL

A. Contractor shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

A. Granular material shall conform to the requirements for Class II, as specified in MDOT Section 902. Granular Material shall be natural bank run sand.

2.02 COARSE AGGREGATE

A. Coarse aggregate shall conform to the requirements for 6A, as specified in MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

A. The area within the vicinity of the new Work shall be dewatered in accordance with Section 31 23 19 prior to the excavation operation.

B. Depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.02 SHEETING, SHORING, AND BRACING

A. Contractor shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.

B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. 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.

C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit Plans for this Work to the Engineer for informational purposes only.

D. Sheeting, shoring, and bracing, and excavation shall conform to current federal or state regulations for safety.

E. 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 the Contractor for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.

F. Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.

G. Furnishing, placing, maintaining and removing of sheeting, shoring, and bracing materials shall be at the Contractor's expense unless otherwise indicated in the Proposal.

H. Contractor shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads.

I. Sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

3.03 COFFERDAMS

A. A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work.

B. Alternate methods, where used in lieu of cofferdams, will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for the alternate method.

C. Stream diversion and earth dikes, where used in lieu of cofferdams or a well-point system will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for such construction.

D. Interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.

E. Cofferdams, caissons or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

F. Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion.

G. No timber bracing shall extend into or remain in the finished concrete.

H. Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.

I. Furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at the Contractor 's expense.

J. If the Contractor elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting therefrom.

3.04 EXCAVATION

A. Excavation shall include the site clearing and grubbing, the excavating and disposing of 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. Excavation shall also include the removal of existing structures, as shown on the Plans or as determined by the Engineer.

C. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.

D. Contractor shall keep the limits of excavation operations within a reasonable close conformity with the location and grade, of each structure.

E. Excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. Excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.

F. The excavation shall be of sufficient size to allow for the construction of the new Work, the placing and compacting of the backfill and for the dewatering operation.

G. When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.

H. Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by the Engineer.

I. Excavated material, determined by the Engineer as suitable for backfill may be used.

J. Excess materials shall be disposed by the Contractor, at Contractor's expense, as specified in Section 01 01 89 00.

K. The elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by the Engineer prior to making the change.

L. The surface of all rock or other hard material upon which concrete is to be placed shall be free of all loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.

M. Unsound material underlying proposed structures shall be removed and replaced with granular material approved by the Engineer , in layers not exceeding 6 inches in depth. Each layer shall

be compacted to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 BACKFILL

A. Backfill material shall be placed only after the new Work and backfill material have been inspected by the Engineer.

B. Backfill shall not be placed against any portion of the new Work until the required curing, surface finishing and waterproofing of such portions have been completed. Backfill which will place an unequalized horizontal loading on the new Work shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.

C. Granular material shall be used for backfilling within 3 feet of all manholes, chambers, valve wells, valve boxes, other pipeline structures, footings, piers, abutments, columns, walls, foundations, etc., unless otherwise indicated in the Contract Documents.

D. Spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.

E. After the backfill has been placed and compacted to the flow line elevation of any weep holes indicated on the Plans, the back end of each weep hole shall be covered with not less than 2 cubic feet of coarse aggregate.

F. Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.

G. Backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed earth grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by the Engineer.

3.06 COMPACTING BACKFILL

A. All backfill behind and around the new Work shall be placed in layers, not more than 9 inches in depth, and shall be compacted to not less than 95% of the maximum unit weight.

B. Areas where the density does not affect the construction, as determined by the Engineer, shall be compacted to not less than 90% of maximum unit weight.

C. Backfill material shall be placed as specified in MDOT Section 206.03.B, except for the following modifications. The backfill material shall have a moisture content not greater than 3% above optimum, at the time of compaction. If the material contains an excess of moisture, it shall be dried to the required moisture content before being installed.

D. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by the Engineer, before the succeeding layer is started.

E. Compaction of the backfill will not be paid for separately but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the Contractor, at Contractor's expense, as specified in Section 01 89 00.

B. The construction area shall be graded and left in a neat, workmanlike condition.

C. At a seasonally correct time, the disturbed area shall be raked, having topsoil placed thereon, fertilized and restored per the requirements of Section 32 9219.

3.08 TESTING

A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory approved by the Engineer.

   1. The cost for testing and sampling shall be at the expense of the Owner.

B. The testing laboratory shall furnish the Engineer with two (2) certified copies of the results of all tests. Testing procedures shall conform to current MDOT's Standard Specifications for Construction.

C. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method A, for Granular Materials, and Method C for all other soils.

3.09 DEFECTIVE WORK

A. Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of the Engineer. Any extra testing or sampling required because of apparent deficiencies shall be at the Contractor's expense.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes 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 22 00 - Unit Prices

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 03 30 00 - Cast-in-Place Concrete

E. Section 31 23 16 - Structural Excavation and Backfill

F. Section 31 23 33 - Trenching and Backfilling

1.03 DESIGN OF DEWATERING CONSTRUCTION

A. Geotechnical investigations made in relation to this Project are provided as reference documents. Interpretations of all data and reports, performing any additional investigations, and obtaining any additional data for construction purposes is the responsibility of the Contractor.

B. Contractor shall be responsible for the complete design of all structures and methods proposed for dewatering the project site, including the implementation of materials, tools and equipment proposed for use in the Work.

C. Temporary wiring associated with the dewatering shall comply with applicable portions of the National Electrical Code.

D. 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 of Soil Erosion and Sedimentation Control, Act 451 "Natural Resources and Environmental Protection Act" of 1994; and Section 01 57 13 - Temporary Erosion and Sediment Control. Where applicable, the Contractor shall obtain and pay for all permits and inspections for dewatering construction in accordance with the provisions of PA 451, State of Michigan, 1994, and all local government agencies having jurisdiction. No additional claim for compensation shall be allowed because of the Contractor's failure to obtain or pay for such permits and inspections.

B. Contractor, at Contractor's 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 the 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. 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 in the state of Michigan, 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 other required auxiliary dewatering equipment to ensure continuous dewatering capability. Dewatering, where required, shall be continuous. Dewatering will not be stopped during work stoppage without approval of the 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 a minimum of 200-foot intervals located between dewatering wells. Provide access to monitoring wells by Engineer.

B. Modify dewatering operation if geotechnical instrumentation or survey measurements indicates 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 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 the Contractor's failure to verify such conditions.

3.04 EXISTING STRUCTURES AND UTILITIES

A. Contractor shall make field verification of 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 damage to existing structures and/or utilities caused because of his Work and shall repair such damage at Contractor's expense to the satisfaction of the Engineer or utility owner.

3.05 DRAINAGE OF EXCAVATIONS

A. Contractor shall maintain 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 the Engineer.

B. 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 construction is complete.

C. 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 below the bottom of the excavation. Drainage system methods shall not cause damage to wells or adjacent property.

D. Outlet drainage piping and conduit shall be kept clean and free from sediment. Contractor shall be held responsible for the condition of existing pipes, conduits and structures which Contractor 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 above ground. Sumps and wells, when abandoned, shall be backfilled and compacted to the satisfaction of the Engineer.

3.07 DRILLING

A. Methods used in drilling wells associated with dewatering systems shall be the responsibility of the Contractor and shall be acceptable to the Engineer.

B. Drilling methods shall ensure proper placement of well materials and shall not involve displacement of earth formations.

C. Drilling shall be done with equipment of proper type, in good condition, and acceptable to the 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 the 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.

B. Pumping equipment shall be of proper type and size for the Work, in good condition, and acceptable to the Engineer. Provide anchors and supports necessary 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 Contract Drawings and as determined by the Engineer. Earth fills shall be compacted to a density equal to that of the surrounding undisturbed earth.

END OF SECTION

SECTION 31 23 33
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 57 13 - Temporary Erosion and Sediment Control

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 22 00 - Grading

E. Section 31 23 16 - Structural Excavation and Backfill

F. Section 31 23 19 - Dewatering

G. Section 32 92 19 - Seeding

H. Section 33 11 00 - Water Utility Distribution Piping

I. Section 33 41 00 - 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 C94/C94M: Standard Specification for Ready-Mixed Concrete
2. ASTM C150/C150M: Standard Specification for Portland Cement
3. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
4. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
5. ASTM C1479/C1479M: Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
6. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
7. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
8. American Association of State Highway Transportation Officials
9. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 TEST REPORTS

A. Testing laboratory shall provide the 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 the 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 Contractor's 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 the 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 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS CLASS II

A. Granular Material Class II shall conform to the requirements for granular material Class II, as specified in MDOT Section 902 except as follows. The granular material shall be natural bank run sand with a maximum size of 1-1/2 inches.

2.02 CRUSHED STONE BEDDING

A. Crushed, angular, natural stone material, meeting the requirements of 21AA coarse aggregate as specified in MDOT Section 902. Crushed concrete and slag are not allowed.

2.03 CONCRETE

A. Concrete shall conform to MDOT Section 1004; use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

2.04 FLOWABLE FILL FOR BACKFILLING

A. Materials

1. Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).
2. Water shall meet the requirements of ASTM C94/C94M.
3. ASTM C150/C150M or ASTM C595/C595M, Type I or Type IA.

B. Mixture (Strength 100 to 120 psi)

1. Fly Ash: 2,000 lbs per cyd min
2. Cement: 70 lbs per cyd min
3. Water: Sufficient water to produce desired flowability 700 lbs per cyd

C. The temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit.

D. The 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. The area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 23 19 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. The 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 the Engineer.

C. The trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by the Engineer.

D. The 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. For rigid pipe, the 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 above the top of the pipe shall not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6 thru 12 inch pipe	30 inches wide
15 thru 36 inch pipe	outside diameter plus 16 inches
42 thru 60 inch pipe	outside diameter plus 20 inches
over 60 inch pipe	outside diameter plus 24 inches

1. To support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, the Contractor shall install, at Contractor's 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 4 inches whichever is greater; or at Contractor's expense, install another type bedding, approved by the Engineer. The concrete encasement shall consist of 3,000 psi strength concrete.

F. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches. The maximum trench width for flexible pipe shall not exceed the minimum width by more than 6 inches.

1. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, the Contractor shall install, at Contractor's expense, crushed stone bedding material to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.

G. When, through the Contractor's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, the Contractor, at Contractor's 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 the Engineer to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.

H. 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 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, and conduits next to or crossing the trench; and for the protection and safety of pedestrian and vehicular traffic.

B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions; and 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.

C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit plans for this Work to the Engineer for informational purposes only.

D. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.

E. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No additional compensation shall be paid to Contractor for sheeting, shoring or bracing left in place.

F. 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.

G. Furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at the Contractor's expense.

H. Contractor shall not remove the trench sheeting, shoring and bracing until the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads.

I. 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 6 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 C1479, except as noted.
2. Class R-A:
    a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches 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.
    b. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least 4 inches 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 8 inches or 1-1/4 of the diameter of the pipe, whichever is greater.
3. Class R-B:
    a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches 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.

b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

4. Class R-C:

a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches 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 above the top of the pipe.

b. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

C. Flexible Pipe Bedding:

1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. A continuous and uniform bedding shall be provided in the trench for all buried pipe.

2. Class F-I:

a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of 4 inches and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches.

b. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3. Class F-II:

a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches 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.

b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

c. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

4. Class F-III:

a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four 4 inches 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 above the top of the pipe. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of the pipe.

b. Where allowable trench widths are exceeded, 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 the Engineer.

B. The 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, unless otherwise directed by the Engineer.

C. Backfilling shall not be done in freezing weather except by permission of the Engineer. Frozen materials shall not be used in trench backfilling.

D. The 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 above the top of pipe. 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 the Engineer, are unsuitable. Rocks or stones having a dimension larger than 6 inches shall not be placed within three 3 feet of the top of the pipe. 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 B:

    a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three 3 feet of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.

    b. 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 granular material Class II, unless otherwise indicated on the Plans.

    c. 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 granular material Class II, unless otherwise indicated on the Plans, constructed as herein specified.

    d. 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, unless otherwise specified on the Plans or by the Engineer.

2. 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.

    b. 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, whichever is less.

3. Unless otherwise specified on the Plans or as directed by the Engineer, the trench backfill shall be carried to the adjacent existing ground or proposed grade whichever is higher.

4. 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 buoyancy effect.

3.06 COMPACTING BACKFILL

A. Compaction of the backfill will not be paid for separately but shall be considered incidental to the Work of installation of the pipe and 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 the Contractor, at Contractor's expense, as specified in Section 01 89 00. The construction area shall be leveled and left in a neat workmanlike condition.

B. At a seasonally correct time, approved by the Engineer, the disturbed area shall be raked, having topsoil placed thereon and restored.

1. Restoration with seed, fertilizer and mulch shall be the requirements of Section 32 92 19 .

2. Restoration with sod shall be in accordance with Section 32 92 23.

3.08 FIELD TESTING

A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory suitable to the Owner and approved by the Engineer.

B. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method C.

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 the Engineer.

B. Any extra testing or sampling required because of deficiencies shall be at the Contractor's expense.

END OF SECTION

SECTION 31 50 00
TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work specified in this Section includes initial ground support systems for trenches and near surface excavations for manholes, junction chambers, diversion structures, and miscellaneous concrete structures.

B. This Section does not apply to shafts or tunnel excavations.

C. Minimum designs of temporary excavation support systems for SCS-2-DS, SCS-2-GSS, E-01C-DV, E-10A-MH, E-12A-JN, E-13A-DV, E-18A-DV, and E-18A-JN are included in the Contract Drawings. Temporary excavation support for all the other near surface excavations shall be designed by the Contractor.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M: Carbon Structural Steel

B. ASTM A53/A53M: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

C. ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength

D. ASTM A328/A328M: Steel Sheet Piling

E. ASTM A500/A500M: Cold-Formed Welded

F. ASTM A501/A501M: Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

G. ASTM A572/A572M: High-Strength Low-Alloy Columbium-Vanadium Structural Steel

H. ASTM A690/A690M: High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

I. ASTM A992/A992M: Structural Steel Shapes

J. ASTM F3125/F3125M: High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

K. AWS D1.1/D1.1M: Structural Welding Code – Steel

L. AWPA C2: Lumber, Timber, Bridge Ties and Mine Ties Preservative Treatment by Pressure Processes

M. 29 CFR: US Department of Labor, Occupational Safety and Health Administration, Code of Federal Regulations Title 29 Labor

1.03 DEFINITIONS

A. Initial ground support system: the support installed prior to or concurrent with excavation to maintain stability of the opening until the excavation is closed.

B. Definitions of terms in OSHA 29 CFR, Subpart P - Excavations, 1926.650(b), in its entirety, shall apply to this Section. The following terms are of particular interest to this Section: excavation, trench, protective system, support system, shoring system, sloping system, benching system, shield, trench box, cave-in, and competent person.

1.04 SUBMITTALS

A. Submit Contractor’s designer and specialty Subcontractor qualifications a minimum of 30 days prior to the execution of the excavation. Qualifications shall demonstrate experience in the design and construction of at least three prior projects that are similar in nature including excavation support system types, depths and ground and groundwater conditions.

B. Submit an excavation support plan stamped and signed by a Professional Engineer licensed in the State of Michigan. The plan must be submitted at least 30 days prior to the execution of the excavation, and it shall include the following information:

1. Limits of working area, including minimum lateral distance from the edge of the excavation support system for construction equipment, stockpiled construction, and excavated materials.
2. Maintenance of traffic (if any).
3. Proposed excavation support systems, location, layout, depth, extent of the different types of support relative to existing features and projected structures, and methods and sequence of installation and removal (if applicable).
4. Design assumptions and calculations.
5. Member sizes and thickness, and bending tolerances of structural steel.
6. Connection details.
7. Maximum allowable spacing between bracing points on compression members to maintain stability and alignment.
8. For initial support members installed in advance of excavation, describe: methods of installation, of quality control, and of correcting support system defects exposed by subsequent excavation.
9. List and specifications sheets of equipment to be used for installation of the excavation support systems.
10. Quality of materials to be used (by reference to recognized standards such as ASTM), including but not limited to timber structural members, steel plates, and blocking; steel structural members, plates, and bars; concrete; and grout.
11. Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, and geotechnical instrumentation.

C. For excavations utilizing Cement-Bentonite (C-B) Wall with Embedded Soldier Piles, submit the following:

1. Include description of methods of pre-trenching to clear debris prior to installing guide walls.
2. Provide details of guide walls.
    a. Submit complete descriptions of all equipment to be used in the trench excavation, and in the mixing, storing, circulating, pumping and placing the wall lagging material.
3. Clearances from adjacent and final structures including excavation tolerances.
4. Sequence and details of wall excavation and backfill, set time, and final strength.
5. Schedule of operations including anticipated times for mobilization, trench excavation, mixing, and backfilling the wall for each location.
6. Parameters and assumptions for the cement-bentonite mix including, but not limited to, the slurry density, viscosity, trench stability calculations, and C-B strength upon setting.
7. Location and methods of monitoring and testing cement-bentonite slurry mix to comply with specified requirements.
8. Method of excavating through boulders or other obstructions.
9. Method of monitoring plumbness and deviation of wall during excavation, and details of proposed corrective measures to be implemented if necessary.

10. Methods for checking and proving the cleanliness of trench bottoms prior to placement of soldier piles.
11. Details for placement of soldier piles to be embedded in the walls.
12. Method of maintaining stability of excavated trenches in case of sudden loss of slurry suspension.
13. Measures for preventing slurry from entering utility facilities.
14. Method of protecting slurry operations, including storage, handling, and disposal, during all seasons.
15. Control of drainage, spills, wastes, etc.
16. Method of controlling/containing spoils, slurry, cement-bentonite, within the construction area.
17. Proposed cement-bentonite and/or lean mix concrete mix design.

D. Manufacture's specifications for bentonite including laboratory test results.
   1. Details of testing methods used to verify the effectiveness of mix design, with respect to strength, hydraulic conductivity criteria and acceptance criteria.

E. After construction, provide records of the following information:
   1. Panel and piles identifications
   2. Dates, times, and quantities of panel/pile excavation; end stop and soldier pile placement, if used; tremied concrete placement; and end stop removal, if used.
   3. Plan location, deviation from plan location, and dimensions of the excavation.
   4. Details and locations of any instrumentation installed.
   5. Description of any variations from the Contract Drawings and Shop Drawings

F. For protective systems for trench excavations, submit, as applicable:

G. OSHA soil classifications used in design.
   1. Tabulated data used in design.
   2. For sloping and benching systems, submit trench configurations and maximum allowable slopes.
   3. For shield systems, submit plan indicating the sizes, types, and configurations of structural components; lateral load capacity; and connection details, where shields are to be stacked.
   4. For shield systems or support systems that are manufactured or pre-engineered, submit, in addition, specifications, recommendations, and limitations issued by the manufacturer; and manufacturer's written approval of any deviation from said specifications, recommendations, and limitations.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. For Cement-Bentonite (C-B) wall construction:
      a. Contractor shall meet the same qualifications listed in Specification Section 31 56 00 - Slurry Walls.

B. Testing of bentonite slurry shall be performed by the Contractor as required hereinafter with the results of every test submitted to the Contractor within the time limit specified herein. Testing methods and equipment shall be in accordance with API RP 13B-1.

1. Required Tests:
    a. Density, by mud density balance
    b. Viscosity, by Marsh Cone Method
    c. pH
2. Calibrate density measuring devices (e.g. – Baroid scale) monthly, or more often if necessary, to ensure correct calibration.
3. Slurry sampling and testing: Collect slurry samples for testing in accordance with the requirements herein.

C. Slurry Trench Excavation Bottom Inspection: Contractor shall measure and record the excavation bottom elevation in the presence of the Owner at the following stages to determine whether soil from trench/excavation sides or other sediment has collected:
1. Immediately after excavation to the final depth.
2. Immediately after each cleaning and desanding.

D. Testing and inspection of soldier pile and cast-in-place concrete shall be in accordance with requirements specified elsewhere in the Contract Documents.

1.06 PERFORMANCE REQUIREMENTS

A. General:
1. Select methods of excavation and temporary excavation support systems that are compatible with conditions described in the Geotechnical Baseline Report (GBR) , and with requirements for placement of permanent structures, control of water, safety of personnel, and protection of adjacent property.
2. Temporary excavation support systems shall provide lateral support, prevent loss of ground, limit ground displacements, and prevent damage to adjacent property (i.e. utilities, structures, roadways, and other facilities) through the entire duration of the excavation activities, and until after design strength of the final structures has been reached.
3. Specific methods of initial ground support and groundwater control required in this Section or shown on the Drawings are acceptable support systems. Contractor is solely responsible for any additional construction measures necessary to achieve the requirements of this Section and is solely responsible for any damages resulting from failure to meet the requirements of this Section.

B. Tolerances:
1. Temporary excavation support systems shall be set out and constructed to maintain the minimum clear dimensions for permanent structures as shown on the Contract Drawings and to provide adequate working space to construct the permanent structures.
2. Guide wall tolerances for C-B walls shall be the same as those specified in Specification Section 31 56 00 - Slurry Walls.
3. Verticality of drilled soldier piles and C-B panels shall be checked every 15 feet of depth during excavation of each element as a minimum. Vertical tolerance shall not exceed 0.5% of the depth.
4. The depth of the support of excavation system shall not deviate more than 1-ft from the planned depth, unless accepted by the Owner to accommodate field conditions.

1.07 INITIAL GROUND SUPPORT SYSTEMS SHOWN ON DRAWINGS

A. Contractor shall evaluate the initial support system designs shown on the Drawings and shall provide additional capacity as necessary to ensure the design is fully compatible with the means and methods of construction.

B. Contractor may change the size and configuration of excavation from that shown on the Drawings to accommodate means and methods of construction, subject to approval by the Owner and to minimum requirements and any limitations included in the Contract Documents.

C. Contractor shall be solely responsible for any revision of designs shown, and for design of all connections. The design shall be prepared and sealed by a registered Professional Engineer licensed in the State of Michigan, having at least 5 years of experience designing similar support systems in similar ground conditions.

1.08 INITIAL GROUND SUPPORT SYSTEM DESIGN BY CONTRACTOR

A. Contractor shall be solely responsible for design of initial ground support systems not shown on the Drawings. The design shall be prepared and sealed by a registered Professional Engineer licensed in the State of Michigan, having at least 5 years of experience designing similar support systems in similar ground conditions.

B. Initial ground support systems shall be designed to the minimum ground loads, hydrostatic loads, and surcharge loads provided in the Geotechnical Baseline Report (GBR). Contractor shall verify that ground loads and surcharge loads for design are adequate for the expected ground conditions and are appropriate for the type of support system proposed. Contractor shall add construction loads appropriate to the means and methods of construction.

C. Design of the initial ground support system shall consider:

1. Ground conditions described in the Geotechnical Baseline Report (GBR)
2. Methods for control of surface and ground water
3. Maintenance of soil stability at the bottom of the excavation
4. Deformation of the support system under load
5. The proximity of existing underground and above-ground structures, including buried water lines and gas lines, and the potential effect of their rupture
6. Effects of vibration on adjacent structures, from driving and pulling support elements
7. Loading conditions, including loading due to delay in adding support members, removal of support members, and dynamic loading
8. Placement of permanent lining and structures

1.09 TRENCH EXCAVATIONS

A. Protective systems for trench excavation shall conform to OSHA 29 CFR Subpart P, section 1926.652. Protective systems as defined in 1926.652 include sloping and benching systems, shield systems, and support systems.

B. Shield and support systems pre-manufactured and sold in interstate commerce may be used, provided they are selected as appropriate for the Work by a Professional Engineer licensed in the State of Michigan.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Liner Plates:

1. Conform with the requirements of 31 72 00, Tunnel and Shaft Initial Support Systems.

B. Steel Pile:

1. Structural steel piles shall be rolled steel sections of the weight, shape, and length shown. The material in steel piles shall be structural steel meeting the requirements of ASTM A572/A572M or ASTM A690/A690M. The minimum yield point shall be 50,000 psi.

2. Splices in steel piles shall be made by a full penetration butt weld of the entire cross section. Care shall be taken to properly align adjacent sections so that the axis of the pile will be straight. Splices in the top 10-feet of the piles will not be permitted. All welding shall be performed by qualified welding operators.

C. Timber Lagging:

1. Wood graded for an extreme fiber stress of at least 1,000 psi. Timber dimension shall be 4”x6” nominal with maximum 8’-0” long. The material of Timber lagging shall be Spruce-Pine-Fir, Mechanically Graded or equal.

D. Internal Bracing System:

1. Structural steel: The material in walers, struts, pile bracing, points, caps, and splices shall be structural steel as follows.

a. Wide Flange Shapes: ASTM A992/A992M

b. Other Shapes, Plates, Bars: ASTM A36/A36M

c. Pipe, Pipe Columns, Bollards: ASTM A53/A53M, Type E or S, Grade B standard weight unless noted otherwise

2. Structural HP Shapes: ASTM A572/A572M, Grade 50

a. HSS: ASTM A500/A500M ,Grade B

3. Bolts for connections shall be ASTM F3125/F3125M, unless indicated otherwise. Bolts used to connect dissimilar metals shall be ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

E. Structural members shall be furnished full length without splices unless otherwise indicated or approved by the Owner.

F. Cement-Bentonite Slurry:

1. Portland Cement: ASTM C150/C150M, Type I or Type II.

G. Slurry:

1. Refer to Specification Section 31 56 00 – Slurry Walls for minimum requirements for the slurry mix.

PART 3 EXECUTION

3.01 GENERAL

A. Construct initial ground support systems to line, grade, dimensions, and tolerances that allow permanent structures and pipes to be placed as shown on the Drawings and in accordance with specified tolerances. Initial support systems shall not project into the limits of the permanent structure.

B. Supplement the support system as designed to address variations in ground conditions as they are exposed in the excavation.

C. Install and remove support members following the sequence of operations shown on the Contractor’s design drawings.

D. Develop and maintain firm and uniform bearing of the support system against the ground by advancing the support system in advance of excavation, by timely placement of internal supporting members, by expanding the support system tightly against the ground, or by timely backfill grouting between a non-expanding support system and the ground.

E. Periodically examine initial ground support systems in place to identify loosening or instable ground; loss of ground through the support system; or excessive deformation, overstress, or weakening of the support system.

F. Maintain the initial ground support system in fully functional condition for the duration of its use. Promptly reset, repair, or replace support system elements that settle, become misaligned, were improperly installed, or become damaged.

3.02 INITIAL GROUND SUPPORT SYSTEMS IN SOIL

A. Initial ground support systems for structure excavations in soil shall consist of steel piles (soldier piles) and wood lagging, timber sheeting and bracing, steel ribs and timber lagging, steel ribs and steel liner plates, or comparable systems.

B. Driven or vibrated sheeting shall not be used.

C. Bracing members called for in the initial ground support system design shall be installed within 5 feet of the current excavation bottom in shafts, unless otherwise shown on the Drawings.

D. Coordinate the installation of initial support systems with excavation to prevent heaving or raveling of exposed soils.

3.03 STEEL PILES

A. Install steel piles by pre-drilling or other pre-excavating methods to their proposed tip elevations. Impact and vibratory driving for steel pile installation is prohibited.

B. Contractor shall have equipment on-site able to advance the pre-excavated hole, for installation of the steel piles, through obstructions in the fill and native soils.

C. Within the same day of seating the steel piles in the pre-excavated holes, completely backfill the holes and fully encase the steel piles with concrete of class as specified in the Contract Documents from the pile tip to the ground surface.

D. After completion of structure construction and excavation backfilling, steel piles shall be left in-place and cut off at a minimum three (3) feet below finished grade, unless specified otherwise in this Section.

3.04 TIMBER LAGGING

A. Install lagging with louvered openings (gaps) between boards in accordance with ground conditions encountered in excavations and subject to the approval of the Owner. In no case will the louvered openings be allowed to exceed one (1) inch.

B. Pack louver openings between lagging with filter fabric, hay, excelsior, jute matting, or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking.

C. The maximum permissible height of unlagged (unsupported) face of excavation shall not exceed three (3) feet. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed eight (8) inches.

D. If unstable ground is encountered, take suitable measures (Backfill Grouting or other approved method) to retain the material in-place and prevent loss of ground or movements which may cause damage to adjacent structures or utilities.

3.05 PRE-EXCAVATION AND GUIDE WALL CONSTRUCTION

A. Before commencing cement-bentonite trench, hand or vacuum excavate as required to expose all utilities known to cross or suspected of crossing the footprint of the proposed excavation and to determine the locations of potentially unknown utilities.

B. Pre-excavation (Pre-trenching): Prior to commencing guide wall construction, the alignment of the wall shall be pre-excavated to a minimum depth of 10 feet from top of wall to remove obstructions, rubble, loose fill and unsuitable materials. The width of the pre-excavation zone shall be at least twice the thickness of the C-B wall and shall be backfilled with stable, excavatable material and meet the clean fill criteria required elsewhere in the Contract

Documents. Support of pre-excavation shall be in accordance with the requirements specified elsewhere in the Contract Documents.

C. Guide walls shall be continuous, cast-in-place reinforced concrete placed on a stable subgrade. Where fill debris exists at the guide-wall bearing surface, either remove the debris or stabilize the ground to provide a stable bearing. Use suitable temporary internal bracing or other stabilizing measures as necessary to prevent guide wall movement.

D. Protection: If at any time the safety of any existing or new construction, utilities, roadways, walkways, or other facilities, shall appear to be endangered, take all necessary means to protect such structures, utilities, etc.

3.06 CEMENT-BENTONITE WALL INSTALLATION

A. Panel Excavation:

1. Layout and measure panels taking as reference the outside face of the permanent structures as shown on the Contract Drawings and including the anticipated installation tolerances.

2. Trenches shall be excavated by clamshell, hydromill, or other suitable trenching equipment. The excavating tool shall have a minimum width equal to the specified trench width.

3. Contractor shall always maintain the stability of the excavated trench for the full depth.

4. Contractor shall maintain cement-bentonite slurry in workable condition until completion of the panel excavation.

5. Any deleterious sediment that may settle out of the slurry or fall to the bottom of the trench shall be removed with the excavating tool or other suitable equipment.

6. Check the verticality of the panel during panel excavation at a minimum of 15-foot intervals and make modifications to the excavation procedures as required to maintain verticality and meet the clear dimensions shown in the Contract Drawings.

7. Take all necessary measures to prevent collapse of the excavated slurry trench prior to cement placement. In the event collapse occurs, backfill with lean concrete and re-excavate per approved method.

B. Slurry Mixing and Placing:

1. Bentonite slurry shall be prepared by mixing water and bentonite until the bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

2. The cement shall be thoroughly blended into the slurry until the mix is homogeneous and the cement particles are fully dispersed in the bentonite slurry.

C. Slurry shall be introduced into the trench at the same time trenching is begun and the level of slurry shall be maintained in the trench during excavation.

1. Once the cement-bentonite slurry is introduced into the trench, excavation shall be continuous. The panel shall not be disturbed or joined with a new panel for at least 48 hours or until the hardened cement-bentonite is self-supporting.

2. Leaving a panel open over a weekend or holiday shall be allowed provided slurry levels in the panel are monitored and maintained at all times.

3. Maintain a reserve supply of mixed bentonite slurry equal in volume to 25 percent of the volume of one fully excavated panel. If panel sizes vary, the size of the slurry reserve volume shall be based on the largest panel.

D. Key:

1. Unless otherwise directed, the bottom of the slurry trench will be as shown in the Contract Drawings. The final depth and penetration of the trench shall be measured and checked by the Contractor and approved by the Owner immediately following excavation.

E. Continuity Between Trench Segments:

1. Any time that a trench segment is extended where the slurry in the previously excavated trench has set, the excavation tools will be arranged to re-excavate a minimum 24 inches overlap into the end of the previously excavated trench, measured at the ground surface.

F. Trench Top Treatment:

1. After initial slurry hardening, the top of the completed trench shall be checked for free water or surface depressions. Any free water shall be removed, and the trench shall be filled with slurry to the specified elevation. Following initial set of this additional slurry, the top of the trench shall be covered with material to prevent drying of the slurry. No cover material shall be placed until the trench has been inspected by the Contractor and the Owner.

G. Clean-Up:

1. Material excavated from the trench shall be stockpiled or disposed of per the Contract Documents. After completion of the slurry trench, the work surface shall be cleaned of all excess slurry.

3.07 INTERNAL BRACING SYSTEM

A. Install and maintain support members in tight contact with each other and with surface being supported.

B. Structural members shall be adequately braced against buckling, with factor of safety of at least 1.5 for maximum axial loading condition, including temperature effects.

C. Where required, pre-load bracing members in accordance with methods, procedures and sequence as described on accepted Shop Drawings. Coordinate excavation work with installation of bracing and preloading. Use steel shims and steel wedges, welded or bolted in place, to maintain preloading force, where required, in bracing after release of jacking equipment pressure.

3.08 REMOVAL OF INITIAL GROUND SUPPORT SYSTEMS

A. Support or bracing members shall be removed provided that the removal is sequenced with backfill operations or the construction sequence associated with casting the final lining. Rebracing shall be installed as needed and in accordance with the Contract Documents.

B. Removal of support elements shall be performed in a manner to maintain stability and strength of soils, and to avoid disturbing adjacent utilities and structures. Voids left on the removal process shall be backfilled to prevent subsidence.

C. Support elements may be left in place at Contractor’s expense and with the written approval of the Owner, provided that the top 3 feet below final grade is removed. Provide additional clearance as necessary for new or relocated utility lines or other structures.

3.09 CONTROL OF VIBRATIONS

A. Contractor shall be responsible for adverse effects of vibrations from installing the support systems, regardless of compliance with vibration and air overpressure limits specified herein. In no case shall ground vibration or air overpressure limits be exceeded.

B. Vibration limits and noise limits shall conform to requirements specified elsewhere in the Contract Documents.

C. Monitoring equipment shall conform to requirements specified elsewhere in the Contract Documents.

D. Contractor shall be responsible for monitoring noise and vibration from construction operations.

END OF SECTION

SECTION 32 11 23
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 89 00 - Site Construction Performance Requirements

B. Section 31 23 13 - Subgrade Preparation

C. Section 32 12 16 - 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 D98: Standard Specification for Calcium Chloride
2. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 ALLOWABLE TOLERANCES

A. The finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet.

1.05 TEST REPORTS

A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the thickness of the compacted aggregate. The core drilling, testing for thickness and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 STOCKPILING AGGREGATE

A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.

B. Stockpiling of aggregate, in excess of 4 feet in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified in Part 3 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 902.05.

2.02 CALCIUM CHLORIDE ADDITIVES

A. Calcium chloride additives shall conform to ASTM D98 and as specified in MDOT Section 922.12.

2.03 WATER

A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Potable water from sources approved by Michigan State Department of Public Health 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.

B. Ascertain that excavation and compacted subgrades or subbases are adequate to receive the new Work.

C. Correct defects and deficiencies before proceeding with the Work.

3.02 SUBGRADE CONDITIONS

A. Prior to the placing of any aggregate material, examine the subgrade or subbase to ascertain that it is adequate to receive the aggregate to be placed.

B. If the subgrade or subbase remains wet after all surface water has been removed, the 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 the 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 Plans, 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 Plans or as directed by the Engineer.

B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by the 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 Plans.

B. The depth of any one layer, when compacted, shall not be more than 8 inches. If the required compaction cannot be obtained for the full depth of the aggregate base course, the thickness of each course shall be reduced, or, with the approval of the Engineer, adequate equipment shall be used to compact the aggregate to the required unit weight.

C. 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 95% 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 the Engineer, additional water may be applied to the aggregate by an approved means 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, the Contractor shall limit the weight and speed of Contractor's equipment to avoid damage to the subgrade, subbase or aggregate base course. If the subgrade, subbase or aggregate base course becomes rutted due to the Contractor's operation, the subgrade, subbase or base course shall be removed and replaced until acceptable to the Engineer, at the Contractor's expense.

I. With the approval of the Engineer, chloride additives may be used by the Contractor to facilitate his compaction and maintenance of the aggregate surface. The amount and method of combining the chloride additives are at the option of the Contractor and are at Contractor's 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 Contractor's 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 approved by the Engineer.

3.09 TESTING

A. During the course of the Work, the Engineer may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to the Owner and approved by the Engineer. The cost for testing and coring shall be at the expense of the Owner.

B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 feet per traffic lane. The lane width shall be as indicated on the Plans or as determined by the Engineer.

1. If two (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 1200 square yards of such areas or fraction thereof.

C. Location of the depth measurement will be at the discretion of the Engineer.

D. Maximum unit weight shall be understood to mean the maximum unit weight per cubic foot as determined by ASTM D1557, Method A.

3.10 DEFECTIVE WORK

A. Thickness:

1. Measurements of aggregate base course thickness will be made to the nearest 1/4 inch.

a. Depths may be 1/2 inch less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.

b. In determining the average in place thickness, measurements which are more than 1/2 inch in excess of the thickness indicated on the Plans will be considered as the specified thickness plus 1/2 inch.

2. Locations of the depth measurements will be as specified herein unless otherwise determined by the Engineer. Sections found to be deficient in depth shall be corrected by the Contractor using methods approved by the Engineer.

B. Weight

1. When the aggregate material is measured by weight in 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 6 percent, the excess over 6 percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than 6 percent.

END OF SECTION

SECTION 32 12 16
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 22 00 - Unit Prices

B. Section 01 33 00 - Submittal Procedures

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 23 13 - Subgrade Preparation

F. Section 32 11 23 - 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. AASHTO M 17: Standard Specification for Mineral Filler for Bituminous Paving Mixtures
2. AASHTO M 29: Standard Specification for Fine Aggregate for Asphalt Mixtures
3. AASHTO M 81: Standard Test Methods and Practices for Emulsified Asphalts
4. AASHTO M 82: Standard Specification for Cutback Asphalt (Medium-Curing Type)
5. AASHTO T 180: Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
6. ASTM D244: Standard Test Methods and Practices for Emulsified Asphalts
7. ASTM D692/D692M: Standard Specification for Coarse Aggregate for Asphalt Paving Mixtures
8. ASTM D1073: Standard Specification for Fine Aggregate for Asphalt Paving Mixtures
9. ASTM D2026: Standard Specification for Cutback Asphalt (Slow-Curing Type)
10. ASTM D2027/D2027M: Standard Specification for Cutback Asphalt (Medium-Curing Type)
11. ASTM D2028: Standard Specification for Cutback Asphalt (Rapid-Curing Type)
12. American Association of State Highway and Transportation Officials
13. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition
14. Michigan Asphalt Paving Association

1.04 ALLOWABLE TOLERANCES

A. Following the final rolling, the surface will be tested longitudinally using a 10 foot straightedge at locations selected by the Engineer. The 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:

B. For Bituminous Base Course Mixtures:

1. Multiple Courses:

a. 3/8 inch for top course

b. 3/4 inch for lower courses

C. For Bituminous Surface Course Mixtures:

1. Multiple Courses:

a. 1/8 inch for top course

b. 1/4 inch for lower courses

2. Single Course:

a. 1/4 inch

D. Variations in excess of the specified tolerance shall be corrected as determined by the Engineer.

1.05 MATERIAL REPORTS

A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.

B. Contractor shall provide the Engineer, or his authorized representative, with the certified batch plant delivery tickets prior to the placing of the materials.

C. Contractor shall supply the Engineer with a certified job mix design for each type of bituminous mixture proposed for use on this Project.

1.06 TEST REPORTS

A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the mix design and the thickness of the bituminous paving material.

B. The core drilling, testing for mix design and thickness, and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under this Section.

PART 2 PRODUCTS

2.01 BLENDED AGGREGATE

A. Blended aggregate shall conform to:

1. AASHTO M29

2. ASTM D692/D692M

3. ASTM D1073

4. MDOT Sections 501 and 902

2.02 MINERAL FILLER

A. The mineral filler gradation shall conform to:

1. AASHTO M17

2. Mineral filler, 3MF, as specified in MDOT Section 902.11

2.03 ANTI-FOAMING AGENTS

A. The anti-foaming agents shall conform to anti-foaming agents, as specified in:

1. MDOT Section 904.

2.04 ASPHALT BINDER

A. Asphalt binder for use in production of bituminous mixtures shall be performance graded asphalt binder:

1. 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:

1. ASTM D2026
2. ASTM D2027/D2027M
3. ASTM D2028
4. AASHTO M81
5. AASHTO M82
6. MDOT Section 904

2.06 EMULSIFIED ASPHALT (BOND COAT)

A. Emulsified asphalt for use in pavement construction shall conform to:

1. ASTM D244
2. 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 501except as otherwise specified in this Section.

B. The blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.

C. The aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture of the type as specified on the Plans.

1. Superpave Hot Mix Asphalt Mixtures shall be in accordance with MDOT Section 501.
2. Marshall Hot Mix Asphalt Mixtures shall be in accordance with MDOT Section Special Provision 20SP-501X-01 (latest edition).

D. The bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT "Procedures 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 for the type of mix.

E. Mixtures failing to meet the requirements specified 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 requirements.

F. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.

G. 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 "Uniformity Tolerance Limits" table below.

1. If two (2) consecutive aggregate gradations on one (1), or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, the Contractor shall suspend all operations. Workdays will be charged during the down time.

2. Before resuming any production, the 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 the table below.

Uniformity Tolerance Limits						
			Percentage Passing Designated Sieves			
Type of Course	Range (a)	(b)	No. 8	No. 30	No. 200	Asphalt Binder Content
Top and Leveling	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
(a) This range allows for normal mixture and testing variations. The mixture shall be proportioned to test as loosely as possible to th Job Mix Formula						
(b) This includes all sieve sizes No. 4 and larger listed on the Job Mix Formula						

H. Mixtures exceeding the maximum tolerances listed in the table, or exceeding the maximum limits specified for the master gradation range will be rejected and the Contractor may be required to remove and replace any bituminous pavements which the Engineer determines were constructed with mixtures in the excess of these tolerances.

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 the Engineer.

1. 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 of mixture, but not more than four (4) samples per day.

2. 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 of mixture, but no more than two (2) samples per day.

L. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans.

PART 3 EXECUTION

3.01 EXCAVATION

A. Prior to the installation of bituminous concrete pavement, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades are adequate to receive the bituminous pavement to be installed. Correct 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, the 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 the 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.
3. Equipment shall be in good working order. Equipment shall be subject to inspections and testing during construction.
4. Equipment shall be 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.
5. 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. The screed shall be adjustable to provide for tilting to secure the proper dray 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. The extensions shall also be equipped with a continuation of the automatically controlled spreading augers. The screed and any 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. A manufacturer approved grade referencing attachment, not less than 30 feet in length, shall be used for all lower courses and the first lane of the wearing course.

    b. After the first lane of the wearing course has been placed, a 10 feet 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 8 feet 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 as approved by the 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 1/2 inch and capable of reducing material which is at least six 6 inches in thickness.

2. 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. The cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control.

3. 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.

4. Crushing equipment shall meet the approval of the 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 in length shall be used.

2. 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.

2. Bituminous pavement shall not be heated by a direct open flame.

F. Rollers:

1. Steel-wheel rollers shall weight at least 8 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. The steering device shall respond readily and permit the roller to be directed on the alignment desired.

   b. Rollers shall be equipped with wheel sprinklers and scrapers.

   c. 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 and shall have provisions to lock in the manufacturer's recommended speed, vibrations per minute, and amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.

3. The pneumatic-tired roller shall be of the self-propelled type with a total weight, including ballast, not greater than 30 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 is obtained.

   b. The 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 psi.

   c. The tire pressures shall not vary by more than 5 psi between individual tires. Contractor shall furnish a tire gage which shall be available at all times to enable the Engineer to check the tire pressures.

   d. Contractor shall furnish the 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.

5. Roller shall be equipped with wheel sprinklers and scrapers or mats.

6. 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, or separate spreaders shall be provided for the specific widths required.

4. Rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds/syd.

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 the Engineer at the time of placement of any mixture.

B. Prior to placing any bituminous mixture, the surface of any 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 determined by the Engineer.

3.06 PREPARATION OF AGGREGATE BASE

A. Prior to the placing of prime coats or bituminous mixtures, density, grade and cross section of the aggregate base shall meet the approval of the Engineer.

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. Broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches shall be removed.

B. Longitudinal and transverse joints and cracks shall be cleaned in accordance with Article 3.14 of this Section.

C. Butt joints at the end of surfacing sections and at intersections of adjoining streets shall be made in accordance with Article 3.08 of this Section. The 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 the Engineer, the old surface shall be cut back for at least 5 feet to a depth of at least 1 inch 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 existing bituminous surface course, the edges of the area to be removed shall be cut along straight lines, either perpendicular to or parallel to the direction of travel, for the full depth of the full depth of the surface course; with the cut edge a minimum of 18 inches 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 determined by the Engineer, it shall be saw cut along the edges of the patched area to prevent the tearing of adjoining pavement surfaces during the removal operation.

B. The 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 proof rolling the crushed base to the proper elevation and slope.

B. Additional materials required to fill holes and voids shall be furnished at the Contractor's expense. Additional aggregate, if required, shall be MDOT 20A or 22A aggregate.

C. The material shall be scarified and uniformly pulverized to a maximum size of 2 inches, in addition, 95% to 100% of the material shall have a particle size of 1-1/2 inches 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 the 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 the Engineer.

F. The crushed material shall be rough graded to within 3/4 inch of the final grade as called for on the Plans or as determined by the 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 the Engineer. Excess material shall be removed and disposed of by the Contractor at Contractor's 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% of the unit weight obtained by the AASHTO T 180 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 proof rolled. Proof rolling shall be accomplished with an 18,000 lbs single axle load.

L. 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 determined by the Engineer, the filler material shall be an approved bituminous mixture. 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.

B. The 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 determined by the Engineer, the joint sealants and foreign material shall be removed to a minimum depth of 1 inch by approved mechanical or hand methods.

B. The 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 determined by the Engineer, the existing bituminous surface and any loose or spalled concrete around the joints and cracks shall be removed. 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.

B. Contractor shall remove and dispose of any resulting debris.

C. When allowed by the Engineer, milling materials may be used for temporary wedging.

1. Prior to placing pavement, temporary wedging materials shall be removed and disposed of. 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 the 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 the 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. The bituminous material shall be applied uniformly by means of a pressure distributor. In areas inaccessible to the regular distributor operation, the bituminous material shall 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 the Engineer.

2. The 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/syd unless otherwise specified on the Plans or recommended by the Engineer.

D. When prime coat is applied, the surface course shall not be placed until the prime coat has properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.

E. The prime coat may be omitted or reduced when authorized by the Engineer.

F. The bond coat shall be applied at the rate specified by the Engineer. This rate will be between0 to 0.10 gal/syd on the bituminous or concrete foundation and between 0 to 0.05 gal/syd between subsequent courses.

G. The bond coat material shall be applied ahead of the paving operation for a distance of at least 1500 feet depending on traffic conditions; or as determined by the 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 1000 feet in length;
3. placing the first course of a base course mixture on an earth grade or on a sand subbase;
4. placing base course mixtures in widths less than 8 feet.

B. Bituminous base course mixtures shall not be placed in lifts exceeding, unless otherwise approved by the Engineer. Approval to place lifts in excess of 3 inches will be based on the ability of the 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 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. 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 width.

D. When the application rate for a bituminous wearing course exceeds 220 lbs/syd, the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as authorized by the Engineer.

E. The 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 the 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, 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 the 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. Engineer may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees Fahrenheit prior to placement of the adjacent course.

I. Echelon paving will be permitted when allowed by the Engineer.

J. Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped sections, and at transverse joints. The edges of the initial mat for cold joints shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section.

K. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.

L. Connections with existing surfaces at the beginning and end of resurfacing sections, and at intersections shall be made by feathering out the mix, by constructing a butt joint, or as approved by the Engineer.

M. 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 2 to 4 inches and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat.

1. The 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 the Engineer, the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness. The excess material shall be discarded, it shall not be spread across the surface course.

N. 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 syd 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. The pneumatic-tired roller shall be ballasted to obtain the required ground-contact pressures as directed by the Engineer.

1. To obtain a uniformly textured mat and the desired pavement density, the Engineer may recommend the Contractor to raise or lower tire pressures at any time during the rolling operations.

2. The roller operations shall be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface.

3. 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. 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.

1. Alternate trips of the roller shall be of slightly different lengths.

2. 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 3 to 6 inches 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 tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by the Engineer, and weighting not less than 300 lbs per inch of width.

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 the Contractor's expense.

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 the Engineer in writing, seasonal limitations for placing bituminous mixtures shall be in accordance with the following:

1. Seasonal Limitations:

a. May 5 to November 15

C. Unless otherwise approved by the Engineer in writing, minimum mixture temperature limitations at the time of placement for placing bituminous mixtures shall be in accordance with the following:

1. Mix Temperature Limitations:

Temperature of Surface being Overlayed	Rate of Application of Bituminous Material		
	<120 lbs per syd	120 to 200 lbs per syd	>200 lbs per syd
35 to 39 degrees F			330 degrees F
40 to 49 degrees F		330 degrees F	315 degrees F
50 to 59 degrees F	330 degrees F	315 degrees F	300 degrees F
60 to 69 degrees F	315 degrees F	300 degrees F	285 degrees F
70 to 79 degrees F	300 degrees F	285 degrees F	270 degrees F
80 to 89 degrees F	285 degrees F	270 degrees F	270 degrees F
90 degrees F and over	270 degrees F	270 degrees F	270 degrees F
Bituminous paving will not be allowed when the mix temperature is below these minimum temperatures, nor when there is frost on the grade or existing surface.			

3.23 HEATING BITUMINOUS MATERIALS

A. Bituminous material which requires heating before application shall be heated in such a manner as to ensure 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 ensure the necessary fluidity.

1. Excessively high temperatures shall be avoided.

2. A thermometer shall be provided to enable the Engineer to observe the temperature at any time.

3. Any 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. Any 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 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 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 from the crown and grade of the adjacent pavement. Any variations over 1/4 inch from the established grade shall be corrected as determined by the Engineer.

3.25 CHIP SEAL

A. Seal coating shall consist of one (1) or more applications of bituminous material applied to the prepared surface and one (1) or more coverings of coarse or fine aggregate applied to the bituminous material.

B. Asphalt emulsion shall be CSEA 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 three (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 the 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 the Engineer. Truck wheels shall ride on spread cover material and not on bituminous material.

F. Any 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 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. The final application of cover material shall be swept with a power broom.

K. The 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 two (2) to five (5) days, as determined by the Engineer, depending on the weather and the materials used.

3.26 BITUMINOUS CONCRETE CURB

A. The bituminous concrete curb shall be constructed to the design specified on the Plans or as approved by the Engineer and shall include the conditioning and treating of the surface on which the curb is to be placed.

B. The materials used in the construction and installation of bituminous concrete curbing shall meet the requirements as specified in this Section, and as specified in MDOT Section 904.

C. Bituminous concrete curb mixture shall be Marshall Mix MDOT 4C or 13A as specified in MDOT Special Provision 20_SP501X-XX and in accordance with MDOT Section 501, unless otherwise approved by the Engineer.

D. The bituminous curb shall be constructed to conform to the Plans or as determined by the Engineer. The method of construction shall conform to MDOT Section 805, unless otherwise specified.

E. The bituminous mixture shall be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by the 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 the Contractor's expense.

F. When specified on the Plans or as directed by the 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 the Engineer, without disturbing the curb, and shall be left in a neat and smooth finished appearance.

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 the Engineer. The bituminous surface course shall be placed on a prepared foundation.

B. The bituminous materials used shall be as specified on the Plans, or as approved by the Engineer. Materials acceptable for use are specified in 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 the 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 the Engineer, the prime coat may be omitted.

F. Bituminous mixture shall be placed to the thickness specified on the Plans or as determined by the Engineer.

G. Placing the bituminous mixture shall conform to this Section.

H. When approved by the 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 the Engineer, only one (1) roller may be used with each paver.

3.28 CLEANUP

A. The area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.

B. The backfill shall be compacted, leveled and left in a neat, smooth 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.

3.29 MONUMENT BOXES

A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by the Contractor and shall be East Jordan Iron Works No. 1570, or approved equal.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.30 TESTING

A. During the course of the Work, the Engineer may require testing for mix designs, aggregate gradation and physical properties, bitumen content, compaction or density, and thickness of material. The testing and coring required shall be performed by a testing laboratory approved by the Engineer.

1. The cost for testing and coring shall be at the expense of the OWNER.

2. The testing laboratory shall furnish the Engineer with two certified copies of the results of all tests.

B. Testing procedures shall conform to current MDOT Standards.

C. Testing of asphalt binders, liquid asphalts, asphalt emulsions, tars shall conform to MDOT Section 904.

D. Rolling shall proceed until the required compaction is attained and the amount of rolling required shall be based on the test results of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 tons, the nuclear gage method will be used to govern the compactive requirements.

E. The control density for the bituminous mixture to be placed, will be determined by use of a modified Marshall Test.

F. Control Density

1. During the Contractor's start-up operations, a rolling procedure to attain the control density will be established.

a. The rolling procedure will be based on the number and type of rollers used and the rolling pattern.

b. The goal of the compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density.

c. Density values less than 98% will be sufficient cause for the Engineer to require an adjustment in the number or type of rollers being used or in the rolling pattern.

2. Once the procedure has been established on the start-up section, the procedure shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.

3. If difficulties are encountered or if there is a significant change in aggregate or bitumen content, the Engineer will determine the control density for the new mixture and require the Contractor to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density.

a. The compactive procedures thus determined shall be used when placing the remainder of that mixture.

4. Density checks will be made at the discretion of the 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.

3.31 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 the Engineer and if in his judgment the defective pavement warrants removal, the Contractor shall remove and replace the affected area at his expense.

a. 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.

B. 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, the Engineer will evaluate the test results and will recommend removal and replacement or a credit to the Owner.

END OF SECTION

SECTION 32 13 15
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 33 00 - Submittal Procedures

B. Section 31 11 00 - Clearing and Grubbing

C. Section 31 23 13 - Subgrade Preparation

D. Section 32 92 19 - 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 A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
2. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
3. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
4. ASTM C150/C150M: Standard Specification for Portland Cement
5. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
6. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
7. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
8. AASHTO T 26: Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
9. 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 the Engineer.

B. At the request of the Engineer, the Contractor shall provide the 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. The core drilling, testing for thickness and compressive strength and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Part 3 of this Section.

1.07 PROTECTION

A. Comply with the requirements for protecting new Work against damage from rain, as specified under Part 3 of this Section.

B. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 CONCRETE

A. Concrete shall conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

B. Ready-mixed concrete in accordance with ASTM C94/C94M, Alternate 2 shall be used unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by the Engineer.

C. Contractor shall provide documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3,500 psi when tested under field conditions.

D. Mixes shall contain a minimum of 25% Type F Fly Ash.

1. Water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans, may be used when approved by the Engineer.

    a. The fly ash quantity may not exceed 40%;

    b. GGBFS quantity shall be not less than 25% nor more than 40%;

    c. Maximum total replacement of cement shall not exceed 40%;

    d. GGBFS and Fly Ash must replace cement on a pound for pound basis.

E. Cement shall be air-entraining Portland cement ASTM C150/C150M, Type 1A. If high-early strength concrete is desired, Type IIIA is required.

F. High-early concrete can be obtained for small areas by the addition of one sack of cement, Type 1A, per cubic yard of concrete (94 lbs/cyd).

G. The air content of the concrete shall be 6.5%± 1.5% by volume.

2.02 WATER

A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

B. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without test.

C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T 26, and as specified in MDOT, Section 911.

2.03 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 911.

2.04 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 the Engineer.

2.05 STEEL HOOK BOLTS

A. Hook bolts shall conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts shall be 5/8 inch (16 mm) diameter.

2.06 JOINT SEALANT

A. Hot-poured type joint sealant shall conform to ASTM D6690, Type II, and as specified in MDOT Section 914.04.

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 all 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 the Engineer, prior to any change.

3.03 FORMING

A. The 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. The 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 4 inches thick except at driveways, where the thickness of the sidewalks shall be 6 inches.

B. Sidewalks shall be 5 feet wide unless otherwise noted on Plans, and shall slope 1/4 inch/ft towards the surface drainage side which in general will be towards the center of the road. Normally sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1 foot from the property line.

C. Driveways and approaches shall be 6 inches thick. The width of driveways and driveway approaches shall be as specified on the Plans or as determined by the 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, the Contractor shall saw cut, to full depth of pavement, and remove a minimum of an 18 inch wide curb and gutter section. When mountable curbs are present, the Contractor shall remove a 24 inch wide curb and gutter section for the construction of sidewalk ramp, as specified above.

C. The length of curb and gutter removal shall be determined by the Engineer in the field but shall be at least as wide as the proposed sidewalk ramp plus 1 foot on each side.

D. The 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 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 the Engineer. Any curbs that are cut or ground down that are not acceptable to the 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 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 the 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, as indicated on the Plans, or as approved by the Engineer.

B. The 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 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 the Engineer.

E. Unless otherwise specified on the Plans or unless otherwise determined by the 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 thick, shall be placed through the sidewalk at uniform intervals of not more than 50 feet and elsewhere as shown on the Plans, or as determined by the Engineer.

G. Expansion joints, 1/2 inch thick, shall also be placed between the sidewalk and back of abutting parallel curbs, 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 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 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. The cut joints shall not be less than 1/8 inchn or more than 1/4 inch 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. All 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. The concrete shall be deposited, in a single layer, to the depth specified in the Plans or in the Proposal. The concrete shall be thoroughly spaded or vibrated and compacted to fill in all the voids along the forms and joints. The 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 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. The curing compound shall not be thinned. The curing compound shall be applied at the rate of 1 gallon per 200 square foot 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. Any concrete that suffers surface or structural damage shall be removed and replaced by the Contractor at Contractor's 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 the Contractor shall have available on the job site at all times enough burlap or 6 mil polyethylene film to cover and protect one (1) day's work.

1. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.

2. 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, the Contractor shall have available on the site sufficient amount of clean, dry straw or hay to cover one day's production.

1. If the temperature reaches 40 degrees F and is falling, the hay or straw shall be placed 12 inches thick, immediately after the curing compound is applied.

2. If the temperature is 30 degrees F and falling the curing shall be by 6 mil polyurethane film placed on the concrete as soon as the surface moisture has disappeared, and then covered with 12 inches of straw or hay.

3. Also, whenever the temperature in the shade falls below 50 degrees F, the water, sand and coarse aggregate shall be heated in that order sufficiently to maintain a uniform temperature of the concrete at between 70 to 80 degrees F.

C. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F.

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. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

B. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 92 19

3.13 TESTING

A. Engineer may require that a minimum of two cores be drilled from the sidewalk for each 500 linear foot (or fraction thereof) section placed. At least one (1) core out of two (2) required will be taken from the sidewalk at the driveway.

B. One (1) core may be required for every 20 driveway approaches or sidewalk ramps installed.

C. The cores shall be checked for depth and compressive strength.

1. The core drilling and tests shall be done by a testing laboratory designated by the Owner and at the expense of the Owner.

2. The testing laboratory shall furnish the Engineer with two (2) certified copies of the test results.

D. 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:

1. Thickness:

Under Required Thickness	Percent of Reduction in Unit Price
0 to 1/4 inch	None
more than 1/4 but not exceeding 1/2 inch	20
more than 1/2 but not exceeding 1 inch	50
more than 1 inch	Remove & Replace

2. Compressive Strength:

Under Required Compressive Strength	Percent of Reduction in Unit Price
0 to 150 psi	None
more than 150 but not exceeding 300 psi	20
more than 300 but not exceeding 500 psi	50
more than 500 psi	Remove & Replace

E. 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 from it when possible.

1. The extra core drilling and testing shall be at the expense of the Contractor.

2. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch and under strength by 200 psi, the total reduction is 20% plus 20% or 40% reduction.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 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 33 00 - Submittal Procedures

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 22 00 - Grading

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with the applicable requirements of the Michigan Seed Law, Act 329, PA of 1965, as amended.

B. Comply with the applicable requirements of the AOSA 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.

1. 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

1. AOSA RULES - Association of Official Seed Analysts

2. ASTM C602: Standard Specification for Agricultural Liming Materials

3. ASTM D977: Standard Specification for Emulsified Asphalt

4. 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.

B. Where required, submit test reports for all seed proposed for use in the Work to the Engineer, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.

C. Contractor shall perform soil tests -1 per designated area - to confirm the fertilizer and lime necessary for the site. Contractor to limit the amount of fertilizer and lime to what is absolutely necessary to ensure optimal growth.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials 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 lbs 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, and August 10 to October 10 and after for as long as weather permits preparation of the seed bed without irrigation and the ground is not frozen. 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 newly seeded areas during the progress of the Work and until completion of the turf establishment period.

B. Protect 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 all disturbed areas. These areas shall be maintained until final acceptance of the Work by the Engineer. Engineer will inspect the turf to ensure that the grass seed is well established, weed free, in a growing and vigorous condition. Areas that do not meet the approval of the Engineer shall be re-seeded at the 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		

B. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding per Table 2, unless otherwise indicated on the Plans or as designated by the Engineer.

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 lbs/acre
TUF	All Types	Urban Freeway, Blvds, City Streets	250 lbs/acre
TGM	Medium to Heavy	All	250 lbs/acre
THM	Loamy to Heavy	Home and Business Turf	250 lbs/acre

C. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 MULCHING MATERIAL

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to the Engineer.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to the Engineer.
2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.
3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2 x 3 inch and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber.
4. Blankets shall be produced in the form of a tightly compressed roll 36 ±1 inch wide and approximately 120 feet long. Blanket shall have a fiber net on the outside of the fiber mat.
5. Blanket roll weight, when manufactured, shall average 85 lbs ± 10%.
6. 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 the Engineer.
2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2 x 3 inch.
3. The net shall be furnished in widths of not less than 35 inches.

D. Proprietary Mulch Material:

1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to the 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 25 to1 ratio of water to adhesive with 25 lbs of recycled newsprint as a tracer.

D. Recycled Newsprint:

1. Mix 7 lbs of newsprint with 7 gallons of water.

E. Guar Gum:

1. Mix 1 lb of dry adhesive with 26.5 gallons of water with 5 lbs of recycled newsprint as a tracer.

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.

B. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected.

C. 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 6 inches 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 1 inch in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

Quality Parameter	Range of Value
Soil pH	5.0 to 7.5
Soluble Salts	500 ppm max
organic content	5 to 30 %

silt content	35% to 50%
clay content	5% to 10%
USDA Soil Classification	Loam or Sandy Loam
deleterious mat'l*	5% max
*rocks, gravel, stones, 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 maximum mesh screen prior to delivery to the Project site.

C. Engineer shall review source and final screen results prior to release of topsoil.

D. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer.

E. Topsoil shall be placed in 3 inch minimum thickness throughout, or as specified in the Plans or Specifications.

F. 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 Contractor's expense.

2.09 IMPROVED TOPSOIL

A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. 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.

2.10 COMPOST

A. 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 and shall be in compliance with all federal and state laws. The mixture shall be free of objectionable odors, 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.

B. 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.

C. The composition of the compost shall be within the following range of values:

Quality Parameter	**Range of Value**
Soil pH	6 to 7.5
Soluble Salts	2 to 5 mmho/cm
Carbon/Nitrogen Ratio	13 to 20 parts Carbon to 1 part Nitrogen
Inerts	< 1%
Organic matter	35 to 55 %
Nitrogen	1 to 2 %
Phosphorus	0.2 to 0.8 %
Potassium	0.5 to 1.5 %
Unit Weight	535 to 775 Kg/m3
Moisture Content	40 to 50 %
Particle Size	< 20 mm maximum
Water Holding Capacity	> 100%
Heavy Metals	None

1. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

2. 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.

3. 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.
4. To comply with the annual filing requirements, the supplier of the compost shall certify that the compost meets EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.
5. A data sheet shall accompany the certification.
    a. The data sheet shall show the following:
    b. 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.
    c. Organic content
6. Inert contamination
    a. Soluble salts
    b. Carbon/Nitrogen ratio
    c. Proof of maturity/stability acceptable 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.

B. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of 2 inch 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 4 inches.

B. 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 Part 3 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 the 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 the Engineer, to a depth of 4 inches or to such depth as specified on the plans.

B. 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, large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by the Contractor.

3.05 FERTILIZING

A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 660 lbs per acre of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs per acre of chemical nutrient.

B. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1 inch.

C. 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 mph shall not be permitted.

B. Prior to placing seed materials, water topsoil to a depth of 4 inches 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 the 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.

D. Rate of broadcast shall be as specified herein or per the written recommendations of the Producer of the seed material used.

E. Roll seeded area with roller weighing a maximum of 150 lbs per foot of width.

F. 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 the Engineer. Seed slurry mixture shall be distributed uniformly at a rate approved by the Engineer for the seeding materials and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs per acre.

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 the rate of water evaporation and prevent 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:

1. Small grain wheat straw or grass hay applied at 1-1/2 to 2 tons per acre with disc packer, asphalt or netting tie-down.

2. Wood chips applied at 6 to 9 tons per acre.

3. Asphalt emulsion alone at 600 to 1200 gallons per acre. (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)

C. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:

1. Straw or grass hay applied at 1-1/2 to 2 tons per acre, anchored with asphalt or netting tie-down.

2. Asphalt emulsion alone at 600 to 1200 gallons per acre. (Limited to areas where tracking is not a problem.)

D. Anchor straw or hay mulch by the methods as specified herein.

E. Wood chips will not need anchoring when used on workable slopes.

F. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with the manufacturer's printed instructions for the material used.

G. 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 3 inches.

H. 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.

1. Apply emulsified asphalt at 200 gal per acre.

2. Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water.

3. Apply liquid (cut back) asphalt at approximately 485 gal per acre.

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.

B. Contractor shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.

C. The seeded areas shall be mowed with mowing equipment acceptable to the Engineer to a height of 2 inches whenever the average height of grass establishment reaches four 4 inches.

When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass.

D. 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.

E. Reseed and mulch areas larger than 4 sq inches not having a dense, uniform, vigorous stand of grass acceptable to the Engineer.

F. 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 the Engineer. The minimum period shall be 30 days.

G. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by the Contractor, the Owner may reseed the defective areas and all costs will be deducted from the Contractor's payments.

END OF SECTION

SECTION 33 05 13
MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes Monolithic concrete manholes with lid frame, covers, anchorage and accessories, as well as modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 04 05 11 - Mortaring and Grouting

C. Section 03 30 00 - Cast-in-Place Concrete

D. Section 31 23 16 - Structural Excavation and Backfill

E. Section 31 23 19 - Dewatering

F. Section 31 23 33 - Trenching and Backfilling

G. Section 31 70 00 - Tunneling and Mining

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 REFERENCE STANDARDS

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ACI - American Concrete Institute

2. ASTM - ASTM International

1.05 SUBMITTALS

A. Shop Drawings: Indicate manhole and vault locations, elevations, piping, conduit, and sizes and elevations of penetrations.

B. Product Data: Provide manufacturer’s data and installation instructions for precast manhole and vault sections, joint connections, water stops, gaskets, corrosion protection system, flexible pipe joints, chimney seals, manhole and vault castings, and other pertinent information for precast and cast-in-place manholes and vaults.

C. Manufacturers Certification: Certify that all products furnished meet or exceed the specified requirements, including worst case depth loadings for this project.

D. Calculations: Submit calculations for review sealed and signed by a registered Professional Structural Engineer in the State of Michigan. Include structural, depth of bury, buoyancy, and all other information necessary to determine adequacy of the item.

E. Results of manhole and vault leakage and vacuum tests.

1.06 CLOSEOUT SUBMITTALS

A. The following shall be submitted in accordance with Section 01 77 00 - Closeout Procedures:

1. Manufacturer's field reports.

B. Project record documents:

a. Accurately record actual locations of manholes, connections, and invert elevations.

b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C890 "Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures." Provide lifting inserts designed for four times the anticipated lifting load. Grout inserts in place when complete.

C. Design of Joints for Precast Structures: Gaskets in accordance with ASTM C923/C923M "Standard Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals" with maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

D. Use precast concrete manholes or vaults designed by the precast manufacturer's registered Professional Structural Engineer, licensed in the State Michigan of in accordance with the Contract Documents. Furnish precast concrete manholes, however, conforming to the following minimum design requirements in addition to the ASTM standards referenced in this Section:

E. The top slab of all manholes or vaults shall be designed for an H-20 truck loading.

F. Minimum manhole or vault base slab thickness shall be eight (8) inches up to twenty-five (25) feet depth and twelve (12) inches over twenty five (25) feet depth.

G. Manholes and vaults shall resist buoyancy due to flooding with a high ground water table elevation at the top of the precast concrete structure. The factor of safety against buoyancy shall be 1.20. Buoyancy calculations shall be provided with the submittal.

H. Walls backfilled with cohesive soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height for walls below the ground water table.

I. Walls backfilled with granular soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height for walls below the ground water table.

J. Design walls for surcharge load from adjacent structures or minimum 300 psf surcharge, whichever is greater.

K. Loads associated with testing manholes and vaults for water-tightness by vacuum testing in accordance with this Section.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with precast concrete manufacturer’s instructions for unloading, storing and moving precast manholes, vaults and drainage structures.

B. Store precast concrete manholes, vaults and drainage structures to prevent damage to Owner’s property or other public or private property. Repair property damaged from materials storage.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

1.09 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.01 VALVE VAULTS, MANHOLES, FRAMES, AND COVERS

A. Valve Vaults and Manhole Manufacturers:

1. Northern Concrete Pipe, Inc.
2. Mack Industries
3. Engineer-approved equal

B. Manhole and Vault Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

C. Benching:

1. Provide full height and poured-in-place benching.
2. Use non-shrink grout as specified in Section 04 0511.
3. Appropriate granular filler may be used, subject to the approval of Engineer.

D. Watertight Cover and Frame Manufacturers:

1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
2. Neenah Foundry Co. - Model R-1916-F.
3. Engineer-approved equal

E. Cover and Frame Product Description:

1. ASTM A48/A48M, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.02 OTHER MANHOLE AND VAULT COMPONENTS

A. Steps: Per Contract Drawings.

B. Base Slab:

1. Per Contract Drawings, cast-in-place concrete of type specified in Section 03 30 00 - Cast-in-Place Concrete or integral, monolithically cast precast concrete or standard tee pipe base sections.

C. Pipe to Manhole/vault Connection:

1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM C923/C923M, to connect pipes to the manhole. Use an A-Lock press wedge, Kor-n-Seal, or Res-Seal connector. No substitutions will be allowed. Non-shrink grout may only be used per the Contract Drawings or with written permission of Engineer.

D. Manhole and Vault Chimney Seals:

1. As shown on the Contract Drawings, seal the outside of the manhole or vault cone or riser section to the grade rings and manhole and vault frame with a heat shrinkable wrap or a compressible rubber seal with 304 stainless steel compression bands.

E. Manufacturers:

1. Canusa - WrapidSeal Manhole Encapsulation System
2. Cretex Specialty Products - External Manhole Seal
3. Engineer-approved equal

2.03 CONFIGURATION

A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female gasketed joints; flexible rubber joint to receive pipe.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: As indicated on Contract Drawings and as required for construction.

D. Design Depth: As indicated on Contract Drawings and as required for construction.

E. Clear Lid Opening: As indicated on Contract Drawings and as required for construction.

F. Pipe Entry: Provide openings as indicated on Contract Drawings and as required for construction.

G. Steps: As indicated on Contract Drawings and required by applicable safety code.

2.04 BEDDING AND COVER MATERIALS

A. Structure and Pipe Bedding: Fill Type A1, A2 or A5 as specified in Section 31 23 33 - Trenching and Backfilling and on the Contract Drawings.

B. Topsoil Fill Type: S3 or S4 as specified in Section 31 23 33 and on the Contract Drawings.

C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1 or S2, as specified in Section 31 23 33 and on the Contract Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify items provided by other sections of Work are properly sized and located.

B. Verify that built-in items are in proper location, and ready for roughing into Work.

C. Verify excavation for manholes or vault is correct.

3.02 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

D. Prepare manhole or vault for installation of chimney seals per manufacturer’s instructions.

3.03 INSTALLATION

A. Excavation and Backfill:

1. Excavate for manholes, vaults and drainage structures in accordance with Section 31 23 16 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.

2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes, vaults or drainage structures in dry trench.

3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

4. Placement and compaction of surrounding backfill material shall be accomplished to provide sufficient and equal side pressure on the manhole or vault.

5. Backfill excavations for manholes, vaults and drainage structures in accordance with Section 31 23 16.

6. Form and place manhole cylinder or vault wall plumb and level, to correct dimensions and elevations.

7. Connect pipe with flexible rubber joints as shown on the Contract Drawings.

8. Set cover frames and covers level without tipping, to correct elevations.
9. Install chimney seals per manufacturer’s instructions and Contract Drawings.
10. Coordinate with other sections of Work to provide correct size, shape, elevation, and location.
11. Use manufacturer's recommended method, procedure and equipment for handling, installing, and connecting the manholes or vaults.

3.04 STANDARD PRECAST CONCRETE MANHOLE, VAULT AND DRAINAGE STRUCTURE INSTALLATION

A. Prepare granular bedding as shown on Drawings, to receive integral, monolithically cast base slab as specified.

B. Lift precast structures at lifting points designated by manufacturer. Grout all lifting holes when structure is in place.

C. When lowering manholes, vaults and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

D. Set precast structures bearing firmly and fully on granular bedding, compacted in accordance with provisions of Section 02320 or on other support system shown on Contract Drawings.

E. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

F. Remove foreign materials from joint surfaces and verify gaskets are installed properly.

G. Maintain alignment between sections by using guide devices affixed to lower section.

H. Verify manholes, vaults and drainage structures installed satisfy required alignment and grade.

I. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Connect pipe to manhole or vault with a flexible rubber joint as specified. Fill annular space with mortar.

J. Cut pipe to finish flush with interior of structure.

K. Shape inverts through manhole or vault as shown on Contract Drawings. Provide cast-in-place full height benching. Trowel smooth and slope to drain per Contract Drawings.

3.05 CASTINGS INSTALLATION

A. Set frames using a precast concrete grade ring with butyl rope to seal joint. Use grade ring sizes per Contract Drawings

B. Unless Contract Drawings indicate otherwise, set frame and cover 6 inch above finished grade for manholes, vaults and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

C. Set frame and cover flush with ground surface for manholes, vaults and other structures located within paved areas.

3.06 LEAKAGE TESTING FOR MANHOLES AND VAULTS

A. After completion of manhole or vault construction, inspect all manholes for leakage and repair all visible leaks.

B. After repairing all leaks, test manholes and vaults for water-tightness using vacuum testing procedure as follows:

C. Temporarily plug the influent and effluent lines with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for the pressure required for the test. Place plugs a minimum of 6 inches outside the manhole or vault walls. Brace inverts to prevent lines from being dislodged.

D. Install vacuum tester head assembly at the top access point of the manhole or vault and adjust for a proper seal. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure. Do not over-inflate.

E. Evacuate manhole or vault with vacuum pump to 10-inches of mercury (Hg). Disconnect the pump and monitor vacuum for the time period specified in the following table (Use equivalent volume for testing vaults):

Depth (feet)	48" Dia. MH	60" Dia. MH	72" Dia. MH	96" Dia. MH
4	30	30	30	30
8	30	30	32	38
12	30	39	48	57
16	40	52	64	76
20	50	65	80	95
24	60	78	96	114
+2	+5	+6.5	+8	+9.5

F. If the drop in vacuum exceeds 1-inch of mercury (Hg) over the specified time period, locate the leaks and complete repairs necessary to seal the manhole or vault. Repeat the test until acceptable results are obtained.

3.07 FIELD QUALITY CONTROL

A. Test concrete in accordance with Section 03 30 00.

B. Vertical Adjustment of Existing Manhole and Drainage Structures:

1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.

2. Reset existing frames, grates, and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated in the Contract Drawings.

4. Clean and apply sand-cement-bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 30 00.

END OF SECTION

SECTION 33 30 00
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 23 16 - Structural Excavation and Backfill

B. Section 31 23 19 - Dewatering

C. Section 31 23 33 - 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 A48/A48M: Standard Specification for Gray Iron Castings
3. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4. ASTM A153/A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
6. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
7. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
8. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
9. ASTM B766: Standard Specification for Electrodeposited Coatings of Cadmium
10. ASTM C12: Standard Practice for Installing Vitrified Clay Pipe Lines
11. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
12. ASTM C55: Standard Specification for Concrete Building Brick
13. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
14. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
15. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
16. ASTM C150/C150M: Standard Specification for Portland Cement

17. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
18. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
19. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
20. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
21. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
22. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
23. ASTM C828: Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
24. ASTM C969: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
25. ASTM C1091: Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines
26. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
27. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
28. ASTM D2680: Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
29. ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
30. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
31. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
32. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
33. ASTM F679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
34. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
35. ASTM F1417: Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
36. ASTM F1803: Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
37. ASTM F2487: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines
38. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
39. NASSCO - National Association of Sewer Service Companies
40. NCPI - National Clay Pipe Institute

1.05 SOURCE QUALITY CONTROL

A. Laboratory test not less than one (1) percent, with a minimum of three (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 foot per 100 feet, and not more than 0.2 feet in total for a sewer run from manhole to manhole.

B. Alignment of sewer shall be within0.2 foot per 100 feet and within 6 inches in total for a sewer run from manhole to manhole.

1.07 SUBMITTALS

A. Submit independent grade checks in accordance with Part 3 of this section.

B. Submit manufacturer's data for pipe bulkheading devices in accordance Part 3 of this Section.

C. A complete field report of the location of all wyes, risers and building leads shall be submitted to the Engineer at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

1. The complete field report shall include witnessing by the Contractor of the ends of all building leads placed. Witnessing shall consist of recording three (3) horizontal distances to the nearest 1 foot with the lines of measurement at minimum angles of 45 degrees with respect to one another.

2. Witnessing shall also include recording of the depth to nearest 6 inches from the invert at the end of the lead to the finish ground above the end of the lead.

3. 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 the Engineer. The report shall contain the precise location of each wye, notes, photographs, and other pertinent information.

E. Submit two (2) copies of the laboratory test reports required per Part 1 of this Section to the 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. 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. All 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 the Contractor.

B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of the Articles in Part 2 of this specification section to specify in detail the various types of sewer pipe, joints, manholes, etc. which have been indicated throughout the Plans and Specifications. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 CLAY PIPE SYSTEMS

A. Pipe shall conform to ASTM C700, extra strength vitrified clay pipe.

B. Joints for all clay pipe shall meet the requirements of ASTM C425.

1. Joints for house leads shall be limited to approved compression type joints with the sealing element bonded to the bearing surfaces.

C. Only lubricant as supplied by the pipe manufacturer shall be used on the bell and spigot in making up joints and the joints shall be coupled in accordance with the pipe manufacturer's requirements.

D. Wyes and tees shall be manufactured to the same standards as the pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.03 PRECAST CONCRETE PIPE SYSTEMS

A. Non-reinforced Concrete Pipe:

1. Pipe shall conform to ASTM C14, Class III, nonreinforced concrete sewer pipe.

B. Reinforced Precast Concrete Pipe System:

1. Pipe 12 inch through 30 inch diameter shall be ASTM C76, Class II through V (as specified on the plans), Wall B or Wall C, circular reinforced.

2. Pipe 36 inch through 108 inch diameter shall be ASTM C76, Class I through V (as specified on the plans), Wall B or Wall C, circular or elliptical reinforced.

a. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used:

1) 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 and a maximum of . 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.

2) 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.

3) Prior to shipment of the pipe, they shall be striped along the inside top with a minimum wide indelible marker so that final inspection of the pipe orientation can be made following completion of the installation.

3. For pipe 114 inches or larger in diameter, the design information in accordance with Section 6 of ASTM C76 shall be submitted to the Engineer for approval, prior to fabrication. The design of all 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:

a. Section 6.1 of ASTM C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of ASTM C361, "Rubber Gaskets." Also, Section 5 of ASTM C443 shall be limited to a modified grooved tongue to receive an "O" ring rubber gasket.

2. For concrete pipe sizes 12 inch through 24 inch, the modified grooved tongue and bell ends of the pipe shall be made smooth and shall not have over a 3-1/2 degree slope

formed to fit the rubber gasket to tolerances as determined by the manufacturer. Pipe tongue shall not be out of round by more than ± 1/16 inch.

3. For pipe sizes 27 inch through 108 inch , 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 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 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 2 inches.

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. All joints in concrete pipe 36 inches in diameter and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland Cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for dry packing.

D. Wyes and Tees:

1. Wyes and tees shall be manufactured to the same standards as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.04 ABS PIPE

A. ABS Truss pipe shall be ASTM D2680, Acrylonitrile- Butadiene-Styrene (ABS). 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 Acrylonitrile-Butadiene-Styrene (ABS) composite pipe shall be per ASTM D2680, Type S.C., a solvent-cemented joint in which pipe solvent cements into a coupling socket to form the joint closure. Installation of the solvent cement shall be in strict accord with the manufacturer's recommendations.

C. Wyes and tees shall be manufactured to the same standard as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.05 PVC TRUSS PIPE

A. Polyvinyl Chloride (PVC) truss pipe shall be ASTM D2680. The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.

B. Joints for Polyvinyl Chloride (PVC) pipe shall be elastomeric gasketed conforming to ASTM D3212, push on type joint.

C. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There

shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.06 PVC SOLID WALL PIPE

A. PVC Solid Wall Pipe in sizes 6 through 15 inch shall be ASTM D3034, SDR 35, and in sizes 18 through 27 inch shall be ASTM F679, SDR35, polyvinyl chloride pipe (PVC).

B. Joints for polyvinyl chloride pipe (PVC) shall be ASTM D3212, push-on type. A joint in which an elastomeric ring gasket is compressed in the annular space between a bell end or socket and a spigot end of pipe.

C. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.07 DUAL WALL CORRUGATED PVC PIPE – SMOOTH INTERIOR

A. Dual Wall Corrugated PVC Pipe (DWCP) shall be a single extrusion of PVC with a smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless. 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.

B. 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.

C. 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.

1. 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.

D. 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.

E. Acceptable manufacturers of Dual wall corrugated PVC pipe include Contech A2000, Uponor ETI Ultra-Corr or Engineer approved equal.

2.08 CLOSED PROFILE PVC PIPE

A. Closed Profile PVC Pipe (CPPP) and fittings shall be manufactured in accordance with ASTM F1803.

B. PVC profile wall pipe shall be made from a compound meeting the requirements of cell classification 12364A as defined by ASTM D1784.

C. PVC profile wall pipe joints shall be rubber gasketed, bell and spigot type joints.

D. Gaskets shall meet the requirements of ASTM F477 and be molded into a circular form or extruded to the proper section, then spliced into circular form, and shall be made of a properly cured high grade elastomeric compound.

E. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Field installed gaskets and field cut beveled lengths of pipe shall be done in accordance with the manufacturer’s instructions and recommended equipment and materials.

F. All pipe gaskets and spigots will be thoroughly cleaned and lubricated before assembly.

G. Manhole connections shall be made with ALOK or Press Seal PSX rubber couplings only. No other connections are allowed.

H. The pipe shall be handled with nylon slings. Cables or chains shall not be used.

I. Lateral connections to PVC profile wall pipe may be made using Inserta-tee as manufactured by the Fowler Manufacturing Company, or the Predco Fast Fit tap system.

1. All saddle or tapping tees will be installed per manufacturer's recommendation.

J. Exposed channels in field cut ends need to be plugged with 3M Industrial Sealant DP-605 or approved equal.

K. Acceptable Manufacturer of Closed Profile PVC Pipe is Lamson Vylon Pipe.

2.09 STRUCTURES

A. 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 which may require limited use of concrete block or brick as approved by the 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/C150M, 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/C478M and shall be circular with circular reinforcement.

a. 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.

b. Base slab shall be minimum 8 inches thick for depths up to 25 feet and minimum 12 inches thick for depths greater than 25 feet.

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:

a. connections to existing sewer 15 inches and smaller on straight through runs and depths no greater than 20 feet;

b. and on right angle runs, with a maximum of four cutouts for depths up to 12 feet.

c. 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.

d. 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.

5. The openings for sewer pipe shall be cast in the manhole section by the manufacturer.

6. Connections to manholes for pipe sizes 6 through 24 inch shall use a mechanically compressible flexible joint, as indicated on the Plans.

7. Connections to manholes for pipe sizes 27 inch and larger shall be grouted, as indicated on the Plans.

8. Manhole sections 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 ASTM C990 and having a nominal size of 1 inch.

9. 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.

10. Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with "O" ring gaskets.

11. Manholes on sewers to be subjected to air tests shall be equipped with a 1/2 inch diameter galvanized capped pipe nipple extending through the manhole wall, 3 inches into the manhole, and at an elevation equal to the top of the sewer pipe.

12. Pipe, 48 inches in diameter or larger, shall be installed as an integral part of the manhole (manhole tees) which shall be constructed of 3,500 psi concrete placed in one continuous pour to 12 inches above the top of pipe as indicated on the Plans.

13. 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.

14. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. The 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/A48M, Class 30, gray iron with a minimum cross section dimension of 1 inch 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 minimum diameter deformed reinforcing bar conforming to ASTM A615/A615M, Grade 60 and shall be in accordance with ASTM C478/C478M.

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/A48M, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects.

2. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

3. For all sanitary manholes, use a bolted waterproof frame with a pressure tight cover. Bolted down frame and cover shall be installed as indicated on the Plans.

2.10 STEEL PIPE

A. Pipe shall conform to ASTM A53/A53M, black and hot-dipped galvanized welded and seamless pipe of standard weight.

2.11 BOLT, STUDS, NUTS

A. Bolt, studs, and nuts shall conform to the following ASTM Standards:

1. Cadmium Plating: ASTM B766, Grade N.S.
2. Zinc Coating: ASTM A153/A153M or ASTM B633, Type G.S.

2.12 CONCRETE

A. Concrete shall conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

2.13 CONCRETE REINFORCEMENT

A. Use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.

B. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A185 for welded wire fabric.

2.14 FLOWABLE FILL

A. Flowable Fill for filling abandoned Water Mains.

1. Materials:
    a. Cement: Cement shall conform to ASTM C150/C150M or ASTM C595/C595M
    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. The water shall meet the requirements of ASTM C94/C94M
2. Mixture Strength (50 to 100 psi):
    a. Fly ASh: 2,000 lbs/cyd minimum
    b. Cement: 100 lbs/cyd minimum
    c. Sufficient water to produce the desired flowability (approximately 700 lbs/cyd)

B. The temperature of the flowable fill mixture as manufactured and delivered shall be at least 50 degrees F.

C. The 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 (7) day and 28 day strengths, together with any other technical information. The design mix shall also be included as part of the Contractor’s submittals for project.

PART 3 EXECUTION

3.01 VERIFICATION OF EXCAVATION AND BEDDING

A. Prior to the installation of any sanitary sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work.

B. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive the sanitary sewer materials to be installed.

C. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING SANITARY SEWERS

A. The Contractor shall expose the existing sanitary sewer and structures to which the new Work is to be connected and notify the Engineer of same. The Engineer will verify the vertical and horizontal locations of the existing system and shall inform the 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. The outside surface of the spigot end and the inside surface of the bell end shall be cleaned and free of any foreign material, other than sealant recommended by the manufacturer, prior to installation.

3.05 EXAMINATION OF MATERIAL

A. All 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 the 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. All pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid shall be checked by the Contractor with line and grade pole or laser system to ensure proper result is obtained.

1. When employing a laser system, the Contractor shall have an alternate and independent means of checking the line and grade. Contractor shall check line and grade every 100 feet.

C. The finished work shall be straight and shall be sighted through between manholes.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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 23 19 - Dewatering, shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is backfilled.

K. Where pipe is located in a flood plain or otherwise susceptible to flotation it shall be anchored against flotation.

L. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33 - Trenching and Backfilling.

3.07 PIPE LAYING

A. Rigid Pipe

1. Installation of rigid pipe shall conform to ASTM C12.

2. 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.

3. 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.

4. 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 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 23 33 - Trenching and Backfilling.

B. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations.

C. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 23 33 - Trenching and Backfilling.

D. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

E. A continuous and uniform bedding as specified in Section 31 23 33 - Trenching and Backfilling, shall be provided in the trench for all buried pipe.

3.09 INSTALLING PVC PIPE IN CASINGS

A. When installed inside of a casing, the pipe shall not rest on the bell as it is pushed into the casing. Casing spacers shall be used in accordance with the manufacturer’s recommendations.

B. Three spacers should be used per pipe length. Follow the casing spacer manufacturers’ recommendation. One of the spacers must be secured to the pipe at the second homing mark; the others should be equally spaced.

C. Joint restraint shall be used in the casing.

D. The annular space between PVC pipe and the casing pipe shall be filled with cellular grout. After installation of pipe in casing, the casing shall be kept dewatered until grouting is completed. Grout shall be placed by gravity flow following recommendations supplied by the pipe manufacturer. The pipe shall be kept full of water during the grouting process. Make certain the void is completely filled around the first pipe before moving on to the next.

1. Block the pipe in place with casing spacers.

2. Fill the entire pipe segment to be grouted with water.

3. Use a lightweight cellular grout mix.

4. Gravity flow or pump the grout into the annular space. Long runs may require pumping – keep the pressure less than 5 psi in the annular space. Pressure shall be monitored with an approved pressure gauge. Extreme caution is advised in pumping grouts in this annular space.

5. All grouting shall be in accordance with pipe manufacturer’s procedures and recommendations.

E. A lightweight cellular grout minimizes floatation forces and can be gravity flowed or pumped at extremely low pressures without collapsing the carrier pipe. The grouting pressures must be closely monitored with a sensitive pressure gauge with 1 to 2 psi graduations. When not controlled, pressure grouting can collapse the PVC carrier pipe.

F. The Contractor shall submit for Shop Drawing approval his procedure for placing the grout, joint restraint, and casing spacers for pipes installed in bores.

3.10 MANHOLE STRUCTURES

A. Construct sanitary sewer manhole and other sanitary structures to the grades, lines and levels indicated on the Plans, or as specified herein.

B. Structures shall be precast concrete, complete with concrete bases, reinforcing, frames, covers, and adjustment rings, as shown and as required for a complete installation.

C. Sanitary manholes as called for on the Plans shall carry a stub opening as specified herein.

D. Wye openings in manholes are prohibited unless indicated on Plans.

E. Sanitary sewer structures shall conform to the type of material and dimensions indicated on the Plans. Construct as detailed on the Plans.

F. Manholes shall be completed and ready for final inspection either before 600 feet of additional sewer construction is completed or within one (1) week after the manhole is constructed, whichever comes first.

G. Block Structures

1. Sanitary manholes may only be constructed with block where specifically shown on the plans or where approved by the Engineer.

2. The first course of concrete block shall be placed on the prepared base in a full bed of mortar.

3. Mortar joints shall be full and closed in all courses. Courses shall be level throughout.

4. 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.

5. Prior to applying plaster coat, block shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

6. 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 thick.

H. Where precast doghouse sections cannot be used, the manhole shall be brick or block to 8 inches above top of highest pipe. Above that point manholes shall be precast concrete as shown on the plans.

I. 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 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.

J. 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.

K. Concrete flow channels shall be constructed in each manhole, as indicated on the Plans.

1. For manholes with outlet pipe diameter of 24 inches 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.

2. 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.

3. The concrete flow channel shall be constructed with a 3/4 to 1-1/4 inch gap provided at the pipe ends to maintain joint flexibility.

L. For manholes with outlet pipe diameters from 27 to 42 inches or for manholes constructed over existing sewers to 42 inches 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.

3.11 SANITARY SEWER STUB OPENING

A. Stub openings shall be at least two (2) pipe lengths, with a minimum length of 10 feet (unless otherwise indicated on the Plan), and the first joint located approximately 18 inches 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.

3.12 VENT ASSEMBLY

A. Provide all materials and construct vent assemblies where indicated on the Plans. Install all piping, fittings, joints, vents, etc., as detailed.

B. Vent assemblies shall be installed on undisturbed earth and provided with restraints as indicated on the Plans, and as required for a complete installation.

C. Vent assemblies shall be connected to manholes as indicated on the Plans.

3.13 DROP CONNECTION ASSEMBLY

A. Provide all materials and construct drop connection assembly where indicated on the Plans. Install all 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 inches 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 concrete collar 12 inches thick shall be poured around the pipe. Drop connections to existing or new manholes shall be made as indicated on the Plans.

3.14 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, all the bulkheads shall be removed, unless otherwise indicated on the Plans or as directed by the Engineer.

3.15 WYES

A. One 6 inch wye or tee branch shall be provided for each lot or parcel 100 feet or less in width that is served by the sewer, or every 100 feet for lots or parcels in excess of 100 feet 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 the Contractor to see that the wyes are so placed.

C. Wyes to developed lots or parcels shall be placed at the location nearest the existing sanitary service lead.

D. If the 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.

E. 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 stopper, as recommended by the manufacturer, to make a watertight closure.

3.16 RISERS

A. Risers shall be installed where the sewer is more than 12 feet below the established grade or future grade, and carried to between 9 to 10 feet of the established grade or future grade, as indicated on the Plans. Pipe 6 inches in diameter, 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.

3.17 BUILDING LEADS

A. All building leads shall be 6 inches diameter pipe and shall be laid on a uniform slope of 1/8 inch per foot unless greater slope will provide depth considered adequate by the Engineer.

B. Building leads shall be provided to within 1 foot 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 of the easement line.

C. Building lead depth, 4 feet horizontal from property line or permanent easement line, shall be between 8 to 9 feet deep. From this point, a 45-degree bend shall be placed and a short length of pipe such that the end depth will be between 5 to 6 feet deep.

D. Building leads under or within 5 feet 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.

3.18 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 by 2 inch (minimum cross section) wooden marker shall be placed from a point immediately in front of the service connection to 1 foot below the finish ground surface. Do not rest the marker on any portion of the service connection or stopper.

3.19 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 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 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 6 inches 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. 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.

3.20 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. The removal of existing structures shall consist of removing and salvaging the existing frame and cover.

2. The ends of the existing sanitary sewer shall be bulkheaded.

3. The top masonry shall be broken down to an elevation at least 30 inches below the proposed subgrade or finished grade.

4. The abandoned structure shall be backfilled with flowable fill to 1 foot above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation.

3.21 FIELD QUALITY CONTROL

A. After all the pipe, structures, and leads have been laid, constructed and backfilled, the system shall be final inspected and tested. The inspection and testing shall consist of the following parts:

1. first inspection
2. television inspection
3. testing

B. 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 four (4) weeks of the completion of the construction.

C. 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.

1. When re-television is necessary, an additional two (2) weeks will be allowed for completion.

D. Testing of the system shall immediately follow the television inspection and shall be completed within a 2-week period.

E. 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.

F. First Inspection

1. The Contractor shall have the underground portion of the sewer system ready for the first inspection within two (2) weeks after the completion of the installation of each 2,000 foot section of sewer.
2. The first inspection shall consist of:
    a. a visible and audible check of the sewers and manholes to ascertain that the manhole steps have been placed,
    b. all lift holes plugged,
    c. the channeling of the manhole bottoms completed,
    d. all visible or audible leaks stopped,
    e. all pipe has been placed straight and true to the proper grades and elevation,
    f. the required adjusting rings and frame and cover properly installed,
    g. all trenches and structures backfilled in a workmanlike manner,
    h. 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.

G. Television Inspection

1. The Contractor shall provide for television inspection of the various sanitary sewer lines installed under this Contract.

2. The Contractor shall arrange for, engage and pay all expenses involved for the services of a competent company to perform this television inspection.

3. The television inspection shall observed by representatives of the Owner, Engineer, and the Contractor. Any television viewing performed in the absence of the 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 8 to 30 inches in diameter inclusive, installed as a part of this Contract.

5. Prior to television inspection, the 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. 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.

7. All observations shall be documented per NASSCO current Pipeline Assessment Certification (PACP) requirements.

    a. Any items which, in the opinion of the Engineer require repair shall be precisely located and photographed along with a detailed statement of the condition.

8. The 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.

    a. Following completion of the repair, the Owner or the Engineer, at their discretion, may require a second television inspection of any repaired areas. The Contractor shall arrange for and pay all costs involved in performing this re-inspection.

9. As a part of the television inspection, the precise location of each wye shall be noted in relation to the downstream manhole. These locations shall be entered on the Wye Location Sheet as supplied by the Engineer and verified by comparison with the locations as established at the time of construction.

    a. Any 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.

10. Two (2) copies of all notes, photographs, wye locations and other pertinent information shall be made as a part of the television inspection.

    a. One (1) set of this information shall be turned over to the representative of the Engineer upon the completion of the inspection of each line.

    b. 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 the Engineer as a complete, comprehensive report on the television inspection of the project.

11. Television inspection shall be recorded and shall be submitted in the format(s) as specified by the Engineer.

    a. DVD Disk

        1) Audio/video route survey submission shall be on DVD media meeting the following specifications:

            (a) DVD-R or DVD+R, 4.7GB, single layer

            (b) DVD – Video

(c) 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) 4x3 (720x480 pixels)

2) No Macrovision or other copy protection encoding. No region code or region code 1.

12. 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.

H. Testing

1. The Contractor shall provide the necessary supervision, labor, tools, equipment and the materials necessary for the tests which shall be conducted in the presence of the Engineer. The 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. All sewers shall be subjected to air, exfiltration or infiltration tests, or a combination of same, prior to acceptance.

1) All sewers over 24 inch diameter shall be subjected to infiltration tests.

2) All sewers of 24 inch diameter or smaller, where the groundwater level above the top of the sewer is over 7 feet, shall be subjected to infiltration tests.

3) All sewers of 24 inch diameter or less, where the groundwater level above the top of the sewer is 7 feet or less, shall be subjected to air tests or exfiltration tests.

b. Exfiltration/Infiltration Test

1) Exfiltration and Infiltration testing will be performed in accordance with ASTM C1091 for vitrified clay lines, C969 for precast concrete lines, F2487 for HDPE lines, or other appropriate standard except as specified herein.

2) If an exfiltration test is performed, the maximum exfiltration rate shall be the same as the permitted from infiltration.

(a) For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus 7 feet as measured from the top of pipe, and the elevation must be at least as high as the highest house service.

3) Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe between manholes per 24 hours for any section of the system and shall include the infiltration from all manholes and other appurtenances.

c. Air Test

1) The procedure for air testing of sewers shall be in accordance with ASTM C828 for Vitrified Clay Pipe, and ASTM F1417 for Plastic Pipe, except as follows:

(a) All 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.

(1) 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.

(2) The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer.

(3) The pressure gauge shall have a minimum diameter of 3-1/2 inch and range of 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

(b) The sewer shall be pressurized to an initial test pressure of 4 psi greater than the greatest back pressure caused by groundwater over the top of the sewer pipe.

(1) At least two (2) minutes shall be allowed for the air pressure to stabilize.

(2) If necessary, air shall be added to the sewer to maintain a pressure within 1 psi of the initial test pressure.

(c) 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 psi of the initial test pressure.

(d) The time required for the air pressure to decrease 1 psi 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.

(e) Manholes on sewers to be subjected to air tests shall be equipped with a capped pipe nipple extending through the manhole wall and at an elevation equal to the top of the sewer pipe. See Part 2 of this specification.

(1) 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.

(2) The tube shall be suspended vertically in the manhole and the groundwater elevation determined by observing the water level in the tube.

(3) The air test pressure shall be adjusted to compensate for the maximum groundwater level above the top of the sewer pipe to be tested.

(4) 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.

2. If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

3.22 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.

B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.

C. 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 nine (9) legs.

END OF SECTION

SECTION 33 34 00
SANITARY UTILITY FORCE MAINS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes underground force main work complete with piping, valves, force main manholes, fittings, thrust blocks, retainers, plugs and accessories required for installation as indicated on the Plans and specified herein. This Section also includes hydrostatic testing of completed portions of new force main.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 77 00 - Closeout Procedures

B. Section 31 23 16 - Structural Excavation and Backfill

C. Section 31 23 19 - Dewatering

D. Section 31 23 33 - Trenching and Backfilling

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. ASME B16.1: Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
2. ASTM A48/A48M: Standard Specification for Gray Iron Castings
3. ASTM A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
4. ASTM A536: Standard Specification for Ductile Iron Castings
5. ASTM A320/A320M: Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
6. ASTM A449: Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
7. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
8. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
9. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
10. ASTM B127: Standard Specification for Nickel-Copper Alloy Plate, Sheet, and Strip
11. ASTM C55: Standard Specification for Concrete Building Brick
12. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
13. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
14. ASTM D2241: Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
15. ASTM D3139: Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

16. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
17. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
18. AWWA C104/A21.4: Cement–Mortar Lining for Ductile-Iron Pipe and Fittings
19. AWWA C105/A21.5: Polyethylene Encasement for Ductile-Iron Pipe Systems
20. AWWA C111/A21.11: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
21. AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast
22. AWWA C153/A21.53: Ductile-Iron Compact Fittings
23. AWWA C300: Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
24. AWWA C301: Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
25. AWWA C504: Rubber-Seated Butterfly Valves
26. AWWA C507: Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm)
27. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.04 SUBMITTALS

A. Tabulated Laying Schedule:

1. Tabulated Laying Schedule, showing stationing, deflection, elevation, slope and description of pieces (i.e., pipe size and material; fitting type, size and material; valve type and size, etc.) shall be submitted to Engineer. Pipe manufacture shall not be started until the laying schedule has been reviewed by Engineer.

B. Product Data:

1. Submit catalog data showing pipe sizes, and manufacturing standards, as well as design calculations for internal pressure, vacuum and external load conditions, for both non-restrained and restrained joints.

C. Quality Assurance Materials:

1. Quality assurance test procedures, test reports for pipes, specials and fittings shall be submitted to Engineer.

D. Submit manufacturer affidavit showing compliance with AWWA Standards for valves.

E. Submit manufacturer's data for restrained joint connections, valves or special fittings.

1.05 CLOSEOUT SUBMITTALS

A. The following shall be submitted in accordance with Section 01 77 00 - Closeout Procedures:

1. Manufacturer's field reports.
2. Project record documents:
    a. Accurately record actual locations of piping mains, valves, connections, and invert elevations.
    b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
3. Provide a final record laying schedule.
4. Submit certified copies of hydrostatic test results of completed force main sections as specified in Part 3 of this specification.

1.06 DELIVERY OF MATERIALS

A. For prestressed concrete pipe systems, provide two (2) percent of pipe lengths to be delivered as short pieces with a length 10 feet or less. These short pieces shall be in addition to those required under the tabulated laying schedule.

1.07 STORAGE OF MATERIALS

A. Pipe shall be stored in a manner to minimize infiltration of dirt, debris, and other extraneous materials.

B. Piping materials shall not be stacked higher than 4 feet. Suitable racks, chairs, and other supports shall be provided to protect performed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers, and chock tier ends.

C. All joint and sealing materials subject to ultraviolet or ozone attack and used in the force main system shall be protected from the sunlight, atmosphere and weather, and stored in suitable enclosures until ready for installation.

1.08 HANDLING OF MATERIALS

A. Load and unload piping using suitable hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall not be used by the Contractor.

B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Cast iron or ductile iron pipe joints shall comply with the requirements due to outside ambient air temperatures specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 SCOPE

A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of pipe, joints, and fittings which have been indicated throughout the Plans and Specifications.

B. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 DUCTILE IRON PIPE

A. Ductile iron pipe shall be AWWA C151/A21.51, with double thickness cement mortar lining inside and 1 mil minimum thickness asphaltic coating outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans.

B. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.

C. Push-on joints for ductile iron pipe shall be compression gasket type conforming to AWWA C111/A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.

D. Fittings and plugs shall be ductile iron, mechanical joint, pressure rating of 350 psi (2.4 MPa), conforming to AWWA C153/A21.53, and AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

E. Nuts and bolts for ductile iron fittings shall be high strength low-alloy steel conforming to AWWA C111/A21.11.

F. Flexible ball and retainer type joints shall be ball and retainer type, boltless, locking, and capable of being deflected up to 15 degrees.

G. Flange joints shall have full face neoprene gaskets, 1/8 inch thick and conform to ASME B16.1.

1. Carbon steel bolts shall conform to ASTM A449 with nuts conforming to ASTM A563/A563M.

2. Stainless steel bolts and nuts shall conform to ASTM A320/A320M.

3. Bolt head and nuts shall be hex.

4. All piping connection bolts and nuts used on this Project including piping in the wet areas shall be cadmium plated.

5. Flange joints shall not be buried.

H. Cement mortar linings for cast iron and ductile iron pipe shall conform to the requirements of AWWA C104/A21.4 of the thicknesses specified and shall be permanently set prior to the application of any additional pipe coating.

2.03 RESTRAINED JOINTS

A. Provide thrust restraints on all fittings and valves.

B. Provide thrust restraints on all couplings within the specified distance from valves and fittings as shown in the thrust restraint schedule in the Contract Drawings.

C. Provide thrust restraint using the following:

1. Mechanical restraint joint couplings: EBAA Series 1100 Mega-Lug or approved equal

2. Locking gaskets: Fast-Grip by American Cast Iron Pipe Company, Field-Lok by US Pipe, or approved equal

D. Restrained joints for ductile iron pipe and fittings shall be designed for a working pressure of 350 psi. Joints shall be capable of being deflected after assembly. Restraints shall be by a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.

E. Restrained joints for PVC force main pipe shall be designed for a working pressure of 200 psi. Where the restrained portion of the pipe is connected to fittings, restraint shall be provided across the joint by a clamping ring and anchored to the fitting with T-head bolts or stainless steel rods. Restraining devices for PVC water main pipe shall incorporate clamping rings with serrations on the inside surface to provide positive restraint on the outside surface of the pipe and shall provide full support around the circumference of the pipe to maintain roundness.

2.04 POLYETHYLENE ENCASEMENT

A. Polyethylene material for encasement shall be either 4 mil high density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film per AWWA C105/A21.5.

2.05 AIR RELEASE VALVE

A. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans or listed in the schedule and a 1/2 inch NPT outlet connection.

B. Valve body shall have 2 inch NPT plugged port near the base to facilitate cleanout of large solids as well as a 1/2 inch NPT connection near the top and 1 inch NPT port near the bottom to permit the installation of flushing attachments.

C. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable. The linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism. Valves shall have 3/16 inch diameter stainless steel orifice for working pressures up to 150 psi.

D. Provide flushing attachments to include flushing valve, 1 inch blowoff valve, 5 feet of rubber hose and quick disconnect couplings.

E. The valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.

2.06 COMBINATION SEWAGE AIR RELEASE AND VACUUM VALVES

A. Wastewater combination air valves shall be constructed of cast iron body and cover, stainless steel plug, guide shaft, bushings and float, Buna-N seat.

B. Valves shall be automatic float operated valve designed to releases air, gas or vapor during filling of a force main and close upon liquid entry, and allow air to re-enter when draining or under a negative pressure.

C. The valve shall also release accumulated air from a force main while the system is in operation and under pressure.

D. The valves shall have working pressure of 150 psi. Provide a backwash system to be included with the valves consisting of an inlet shut-off valve, blow-off valve, clear water inlet valve and rubber supply hose with quick disconnect couplings.

2.07 CONCRETE BRICK

A. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3 inch thickness.

2.08 CONCRETE BLOCK

A. ASTM C139, Type II, shape and scored as detailed and as approved.

2.09 PRECAST CONCRETE UNITS

A. Precast concrete units, flat top slabs, riser, cone, transition sections and bottom sections shall conform to ASTM C478/C478M and shall be circular with circular reinforcement. For depths greater than 32 feet, the 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 minimum 8 inch thick for depths up to 25 feet and minimum 12 inch thick for depths greater than 25 feet.

B. 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.

C. Precast bottom sections shall be cast with the bottom end flat to provide bearing of the full wall thickness. The openings for sewer pipe shall be cast in the manhole and the bottom section by the manufacturer.

D. Riser sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets.

E. 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.

F. Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with "O" ring gaskets.

2.10 MANHOLE STEPS

A. Cast iron manhole steps shall be ASTM A48/A48M, Class 35, with a minimum cross section dimension of 1 inch in any direction.

B. Steel Reinforced plastic manhole steps shall be suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02 with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615/A615M, Grade 60 and shall be in accordance with ASTM C478/C478M.

C. Manhole steps shall be of types and sizes indicated on the Plans and shall comply with applicable state and federal occupational and safety standards.

2.11 COVERS AND FRAMES

A. Structure frame and covers shall be of the types and sizes as detailed on the Plans. Covers shall be Class 30, ASTM A48/A48M gray iron castings. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of castings shall be ground to assure proper fit and to prevent rocking.

2.12 VALVE BOXES

A. Three piece,5-1/4 inch diameter, screw type, gray iron castings conforming to ASTM A48/A48M, Class 20, with adjustable length. Lids shall have "Sanitary Force Main" plainly cast in tops.

2.13 CONCRETE

A. The concrete shall conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

2.14 CONCRETE REINFORCEMENT

A. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.

2.15 RESTRAINTS, CLAMPS, RODS, AND TIES

A. Cast iron or stainless steel as recommended by pipe manufacturer. Bolts, nuts, clamps, rods, ties and fittings shall be bronze alloy or corrosion protected steel.

2.16 ACCEPTABLE MANUFACTURERS

A. PVC Pipe Transition Gland or Gasket

1. Acceptable manufacturers include: Mueller, Tyler, or equal.

B. Combination Air Valves

1. Acceptable manufacturers include: Apco, Val-matic, or equal.

C. Valve Boxes

1. Acceptable manufacturers include: Clow "F-2450," or equal.

D. Restrained Joints

1. Acceptable manufacturers for restrained joints for ductile iron pipe include: Griffin Pipe Products Company, “Snap-Lok” or “Bolt-Lok”; American Cast Iron Pipe Company, “Lok-Ring” or “Lok-Fast”; United States Pipe and Foundry Company, “TR Flex”; Ebaa Iron “Megalug” or Engineer approved equal.

E. Fittings for IPS/PVC Pipe

1. Harco manufactured by The Harrington Corporation.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

A. Prior to the installation of any force main piping or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work.

B. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive force main materials to be installed. Correct all defects and deficiencies before proceeding with the Work.

3.02 PREPARATION OF PIPE ENDS

A. Remove all lumps, blisters and excess coatings from the socket and plain ends of pipe. Wire brush and wipe clean the outside surfaces of all plain ends and the inside surfaces of all socket ends before installation.

B. Any pipe or fitting which has acquired a coating of mud or other adhesive foreign material shall be scrubbed clean.

3.03 EXAMINATION OF MATERIALS

A. All pipe fittings, accessories, and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged materials shall be rejected and removed from the Project by the Contractor.

3.04 INSTALLATION - GENERAL

A. Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe. Plug pipe ends when construction stops overnight or for extended periods.

B. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.

C. 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 pipe materials being cut and according to the best trade practices.

D. When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.

E. Where pipe using a resilient gasket to affect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.

F. Provide restrained joints meeting this specification and as recommended by the manufacturer. Connection shall be made in accordance with manufacturer's recommendations.

G. After the bottom of trench has been excavated, the pipe bedding material will be installed in accordance with Section 31 23 33 - 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 23 33 - Trenching and Backfilling. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

H. A continuous and uniform bedding as specified in Section 31 23 33 - Trenching and Backfilling, shall be provided in the trench for all buried pipe.

I. Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured. Adequate support shall be provided for all force main pipe.

J. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33 - Trenching and Backfilling.

K. All fittings, plugs, adapters, and horizontal and vertical blocking shall be installed by the Contractor as shown on the Plans; and the cost of the same shall be included in the unit price per lineal foot of force main.

3.05 INSTALLATION OF DUCTILE IRON PIPE

A. Push on joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be pre-lubricated before installation using a lubricant recommended by the pipe manufacturer. The seated joint shall be identified by the visible mark on the spigot of the installed pipe section.

B. When the temperature is above 60 degrees F, the spigot end of each pipe lead shall be forced tightly on the bell of the proceeding pipe. When the temperature is below 60 degrees F, the pipe shall be laid with the spigot end 1/16 inch from the face of the bell for expansion.

C. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. All nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturer's recommendations.

D. Exposed portions of bolts shall be covered with mastic.

E. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to the Engineer.

3.06 INSTALLATION OF CONCRETE PIPE

A. All concrete pipe and fittings shall be jointed by means of a resilient gasket and steel spigot ring. The resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe.

B. Pipe shall be laid in accordance with the accepted tabulated laying schedule and the Plans.

C. Short lengths of pipe (10 feet or less) specified under Part 1 of this Section shall be installed and evenly distributed along the line of the Work, if required.

D. The bell of the pipe in place shall be cleaned and properly lubricated before the next pipe section is installed. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final position, prior to driving the pipe home, check each gasket for proper position around the full circumference of the joint and complete the installation.

E. Provide cloth bands wired around each joint outside diameter and grout with Portland cement mortar grout. Completely fill the annular recess between the adjoining bell and spigot pipe ends. Annular spaces between pipe ends on the inside of joints of pipe 24 inches or more in diameter shall be filled with Portland cement mortar grout.

3.07 INSTALLATION OF POLYVINYL CHLORIDE PIPE

A. Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with the pipe manufacturers published instructions. The joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.

B. Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. The pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.

C. When called for on the plans or in the specifications, tracer wire is to be installed along with the force main. Tracer wire is to be continuous from end to end and terminate at each structure in such a way and with a sufficient length of wire to allow for easy connection to utility tracing equipment.

D. Wire shall be continuity tested after installation. Any wire which fails the continuity test shall be replaced.

3.08 SUBAQUEOUS PIPE

A. Provide sections of pipe with joints for subaqueous trench installation as indicated on the Plans. Sections of pipe shall be assembled, bedded and backfilled before connecting to land lines.

B. Sections shall be assembled on shore, then dragged or floated into position for installation.

C. Joints of pipe lengths and connections to land lines shall be in accordance with manufacturer's recommendations.

3.09 INSTALLATION OF RESTRAINED JOINTS

A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer’s directions. All joints shall be fully extended after assembly.

3.10 POLYETHYLENE ENCASEMENT

A. Where called for on the plans, ductile iron fittings and pipe shall be encased in a polyethylene film tube. The polyethylene film tube shall be ANSI/AWWA C105/A21.5, Method A. Method A consists of cutting the polyethylene tube 2 feet longer than the pipe to provide an overlap at the joints. The cost of the polyethylene encasement shall be incidental to the water main.

3.11 ANCHORS AND THRUST BLOCKS

A. Anchors, encasements and restraints shall be provided at the locations and dimensions as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. All bearings shall be as shown. Anchors, encasements and restraints shall rest on firm, stable, compacted bedding and shall be provided for all standard and special fittings.

3.12 VALVES

A. All valves shall be installed to the grade, lines, levels and locations indicated on the Plans.

B. Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.

C. Where required, valves shall be supported with special supports as indicated on the Plans and as approved by the Engineer. Valves shall be installed so as not to receive support from the connecting pipe. In no case shall valve installation be used to bring misaligned pipe into alignment.

D. Provide all materials and install air release and vacuum release valve assemblies at locations indicated on the Plans. Include all valves, reducers, connections and other fittings necessary for installation.

E. Fittings and joint materials shall be compatible to the force main piping material.

3.13 VALVE BOXES

A. Install valve boxes to the grade, lines, levels and locations indicated on the Plans.

B. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations.

C. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

3.14 STRUCTURES

A. Construct structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc., as shown and as required for a complete installation.

B. Construction of structures shall conform to the type of construction and dimensions indicated on the Plans and as described below.

C. Brick Structures:

1. Prior to laying, all brick shall be thoroughly wetted and the surfaces allowed to dry only sufficiently to prevent slippage on the mortar.

2. Broken or chipped brick shall not be used on the faces of the structures.

3. Brick shall be laid in neat, even consecutive courses with full and close mortar joints. Courses shall be level throughout, except as shown or otherwise required. Stagger joints in adjoining courses by one-half a brick as nearly as practicable. At least one (1) course in every seven (7) shall be stretcher courses with intervening courses laid as headers.

4. Length of brick closure pieces shall be not less than the width of one (1) whole brick and, wherever practicable, closures as headers, shall be made from whole brick.

5. Unless otherwise indicated, joints shall be not more than 1/2 inch thick and shall be of a uniform thickness throughout the structure. Joints shall be provided as indicated on the Plans. Exposed surfaces shall be true and smooth. Rake all joints to receive plaster coat.

6. Prior to applying plaster coat, brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

D. Block Structures:

1. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be places on the prepared base or footings in a full bed of mortar. Mortar joints shall be full and close 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.

2. Joints shall be uniform in thickness throughout the structures. Strike all joints and properly point to provide true, smooth surfaces.

E. Precast Structures:

1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide two (2) to four (4) courses of 3 inch brick at top of structure for future adjustment.

F. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick or block force main structures indicated on the Plans. Plaster coat shall be 1/2 inch thick and shall be applied to the outer surfaces of the structures.

G. Provide and install to the elevations shown all cast iron covers, frames, adjusting rings, anchors, etc., indicated on the Plans and as required. Castings shall be set in a full bed of cement mortar 1/2 inch thick minimum. Mortar joints shall be struck smooth.

H. Install steps for structures of types and in locations indicated on the Plans. Steps shall be installed on 16 inch centers minimum.

I. Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

3.15 HYDROSTATIC TESTING

A. After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage. The Contractor shall furnish the pump, pipe connection, blow-off valves and all other necessary apparatus including gages and meters and all personnel necessary for conducting the test.

B. Before applying the test pressure, all air shall be expelled from the pipe. If necessary, threaded taps shall be made at the points of higher elevation and then closed with brass plugs.

C. Any faulty pipe fittings, valves or other accessories which permit leaks during testing shall be replaced by the Contractor with sound material and the test shall be repeated until specified requirements are met.

D. When practicable, tests shall be made on sections between valves, or sections not exceeding 2,000 feet in length.

E. Dead ends, bends and other fittings shall have a firm foundation and be securely blocked against the trench walls before testing or completing the backfill as specified.

F. The full test pressure shall be held for no less than one (1) hour or longer as necessary to permit thorough examination of all exposed joints in the section of main being tested. Test pressure shall be maintained at 150 psi for force mains.

G. Leakage shall be measured by the quantity of water pumped into the pipe to maintain test pressure during test period.

H. All leaks shall be located and repaired until the test meets the following requirements.

I. Maximum permissible leakage of force main shall not exceed the following:

Force Main Diameter Inches (mm)	**Allowable Leakage Gallons/1,000 Feet/Hour (Liters/500 Meters/Hour)**
4 (100) OR LESS	0.5 (3.0)
6 (150)	0.75 (4.5)
8 (200)	1.00 (6.0)
10 (250)	1.25 (8.0)
12 (300)	1.50 (9.0)
14 (350)	1.75 (11.0)
16 (400)	2.00 (12.5)
18 (450)	2.25 (14.0)
20 (500)	2.50 (15.5)
22 (550)	2.75 (17.0)
24 (600)	3.00 (18.5)

3.16 WATER FOR TESTING

A. Water for testing shall be obtained from a water source approved by the Engineer. Contractor shall provide all water required at his own expense and shall make all necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority.

B. Contractor shall provide and remove temporary connections between the source water system and the mains constructed under this Contract. All temporary connections shall meet the approval of the Engineer, the authority controlling the source water system and authorities having jurisdiction.

C. Water for testing shall be removed from the force main by pumping to waste. Water discharge shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage or from creation of hazard to traffic.

3.17 FLUSHING FORCE MAIN

A. At pump station start-up, should the force main flows not meet design requirements, the Contractor shall flush the force main at no additional cost to the Owner.

B. Flushing shall be done using the “poly-pig” method of flushing. The Contractor shall furnish foam “poly-pig” swabs to be used. Prior to pigging and flushing, the force main must be charged with water. The Contractor shall insert “poly-pig” swab in the end of the new main nearest the pump station (or where shown on the Plans). The swab shall be passed through the new main using water pressure. The swab shall be recovered at the end of the main or cleanout.

END OF SECTION

SECTION 40 05 07
PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Scope of Work:

1. This Section specifies hangers and supports for all piping systems specified in Division 40.

B. Qualifications:

1. Piping support systems shall be designed and shop drawings prepared and sealed by a Registered Professional Engineer in the state where the work shall be installed.

C. Operating Conditions:

1. The hangers and supports specified in this Section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this Section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:

a. Hot Systems:

1) 120 degrees F to 450 degrees F

2) 451 degrees F to 750 degrees F

2. Over 750 degrees F

3. Ambient Systems:

1) 60 degrees F to 119 degrees F

b. Cold Systems:

1) 33 degrees F to 59 degrees F

c. -20 degrees F to 32 degrees F

4. Design Requirements:

5. Design, size, and locate piping support systems throughout facility, whether shown or not.

6. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.

7. Piping 30 Inches and Larger: Support systems have been designed for piping shown.

8. Meet requirements of MSS SP-58 and ASME B31.1 or as modified by this section.

D. Hanger and Support Selection:

1. Contractor shall select pipe hangers and supports as specified in the Project Manual. Selections shall be based upon the pipe support classifications specified in this Section and any special requirements which may be specified in the Project Manual.

2. Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of hanger or support to be used at each hanger or support location.

3. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:

a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.

b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

c. Reaction forces due to the operation of safety or relief valves.

E. Wind, snow or ice loadings on outdoor piping.

a. Seismic loads in accordance with governing codes and as shown on structural general drawings.

2. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.

3. Where negligible movement occurs at hanger locations, rod hangers shall be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members shall be used.

4. Hangers for the suspension of size 2-1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

5. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.

6. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.

7. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

8. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

9. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.

10. Stock hanger and support components shall be used wherever practical.

11. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP-58, Table 3 and Table 4.

a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.

b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.

1.02 REFERENCE STANDARDS

A. This Section contains references to the following referenced standards. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Notice to Bidders. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

C. AISC (MAN): American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Ed.

D. FEDSPEC WW-H-171e-78: Hangers and Supports, Pipe

E. MFMA-2-91: Metal Framing Standards Publication

F. MSS SP-69: Pipe Hangers and Supports - Selection and Application

G. MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

1.03 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping 6 inches and larger and 4 inches and smaller. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.

2. Calculations for each type of pipe support, attachment and anchor.

3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

B. Informational Submittals:

1. Maintenance information on piping support system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Grinnell, Erico Caddy, Pipe Shields Incorporated, Superstrut, Unistrut, or approved equal. Pipe support components shall conform to the requirements of MSS SP-69 and FEDSPEC WW-H-171e. Pipe support materials shall conform to the requirements of MSS SP-58. Metal framing system components shall conform to the metal framing manufacturers' Association Standard MFMA-2.

2.02 MATERIALS

A. General:

1. Unless detailed otherwise on the drawings, materials for hangers and supports shall be as follows:

a. Support materials for process piping, including flushing water, service water 4 inches and larger, dewatering piping, in areas subject to moisture or corrosive atmosphere, shall be manufactured and fabricated of ANSI 316 stainless steel.

b. Support materials for all process piping, including flushing water, service water 4 inches and larger, dewatering piping not subject to submergence or corrosive atmospheres shall be galvanized steel, except chemical piping hangers and supports shall be as described above, and piping in finished areas or above suspended ceilings may be galvanized or zinc or cadmium plated.

B. Pipe, Hangers, and Supports:

1. TYPE 1 - CLEVIS PIPE HANGER: Clevis hangers shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 1.

a. Steel pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be B-Line B3100, Grinnell Fig. 260, or approved equal.

c. Cast and ductile iron pipe - shall be B-Line B3102, Grinnell Fig. 590, or approved equal.

d. Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Fig. CT-65, or approved equal.

e. Copper pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or approved equal, with insulation shield.

f. Plastic pipe - shall be B-Line B3100 C, Carpenter & Patterson Fig. 100PVC, or approved equal.

2. TYPE 2 - "J" PIPE HANGER: Hangers shall be carbon steel with configuration and components equivalent to MSS Type 5.

a. Steel pipe - shall be B-Line B3690, Grinnell Fig. 67, Erico Caddy model 418, or approved equal.

3. Copper and plastic pipe - shall be Erico Caddy model 419, Unistrut J 1205N series, or approved equal.

4. TYPE 3 - DOUBLE BOLT PIPE CLAMP: Pipe clamp shall be carbon steel, with configuration and components equivalent to MSS and FEDSPEC Type 3.

a. Steel pipe (insulated) - shall be B-Line B3144, Grinnell Fig. 295, or approved equal, with insulation shield. Insulation shield is optional for hot and ambient systems.

b. Steel pipe (uninsulated) - shall be B-Line B3144, Grinnell Fig. 295, or approved equal.

c. Copper pipe (insulated only) - shall be B-Line B3144, Grinnell Fig. 295, or approved equal, with insulation shield.

5. TYPE 4 - ADJUSTABLE ROLLER HANGER: Rollers shall be cast iron, yoke and cross bolt shall be carbon steel. Configuration and components shall be equivalent to MSS Type 43 and FEDSPEC Type 44.

a. Steel pipe (insulated) - shall be B-Line B3110, Grinnell Fig. 181, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be B-Line B3110, Grinnell Fig. 181, or approved equal.

c. Copper pipe (insulated only) - shall be B-Line B3110, Grinnell Fig. 181, or approved equal, with insulation shield.

d. Plastic pipe - shall be B-Line B3110, Grinnell Fig. 181, or approved equal.

6. TYPE 5 - SINGLE PIPE ROLL: Rollers and sockets shall be cast iron, cross rod shall be steel. Configuration and components shall be equivalent to MSS Type 41 and FEDSPEC Type 42.

a. Steel pipe (insulated) - shall be B-Line B3114, Grinnell Fig. 171, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be B-Line B3114, Grinnell Fig. 171, or approved equal.

c. Plastic pipe - shall be B-Line B3114, Grinnell Fig. 171, or approved equal.

7. TYPE 6 - FRAMING CHANNEL PIPE CLAMP: Pipe clamps shall be steel with galvanized finish and material thickness as listed below:

a. Steel pipe (uninsulated) - Pipe size 3/8 inch and 1/2 inch shall be 16 gage; 3/4 inch through 1 1/4 inches shall be 14 gage; 1 1/2 inches through 3 inches shall be 12 gage; 3 1/2 inches through 5 inches shall be 11 gage; 6 and 8 inches shall be 10

gage; Erico Caddy model 431, Powerstrut PS 1100, Unistrut P 1109 series, or approved equal.

b. Steel pipe (insulated) - Pipe clamp shall be as described in this paragraph 6 with insulation shield.

c. Copper (uninsulated) and plastic pipe - Pipe size 3/8 inch and 1 inch shall be 16 gage; 1 1/4 inches and 1 1/2 inches shall be 14 gage; 2 inches through 3 inches shall be 12 gage; 4 inches shall be 11 gage; clamp shall be copper-plated, plastic coated or lined with dielectric material; Erico Caddy model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or approved equal.

d. Copper pipe (insulated) - Pipe clamp shall be as described in described in this paragraph 6 with insulation shield.

8. TYPE 7 - U-BOLT: U-bolts shall be carbon steel with configuration equivalent to MSS and FEDSPEC Type 24.

a. Steel pipe (uninsulated) - shall be Grinnell Fig. 137, B-Line B3188, or approved equal.

b. Steel pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or approved equal, with insulation shield.

c. Cast and ductile iron pipe - shall be Grinnell Fig. 137, B-Line B3188, or approved equal.

d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 222 CT, B-Line B3501 CT, Grinnell Fig. 137C, or approved equal.

e. Copper pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or approved equal, with insulation shield.

f. Plastic pipe - shall be Grinnell Fig. 137C, Erico Caddy model 151, B-Line B3188 C, or approved equal.

9. TYPE 8 - ADJUSTABLE PIPE ROLL SUPPORT: Rollers and sockets shall be cast iron, cross rod and support rods shall be carbon steel.

a. Steel pipe (insulated) - shall be B-Line B3122, Grinnell Fig. 177, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be B-Line B3122, Grinnell Fig. 177, or approved equal.

c. Copper pipe (insulated only) - shall be B-Line B3122, Grinnell Fig. 177, or approved equal, with insulation shield.

d. Plastic pipe - shall be B-Line B3122, Grinnell Fig. 177, or approved equal.

e. Use of this support should be limited to vertical support applications where approved by the Engineer.

10. TYPE 10 - PIPE STANCHION SADDLE: Saddles and yokes shall be carbon steel and comply with MSS Type 37 and FEDSPEC Type 38.

a. Steel pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or approved equal.

c. Cast and ductile iron pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090 NS, or approved equal.

d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or approved equal, with insulation shield or lined with dielectric material.

e. Copper pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or approved equal, with insulation shield.

f. Plastic pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or approved equal.

11. TYPE 11 - OFFSET PIPE CLAMP: Pipe clamp shall be carbon steel with configuration and components as specified and shall be of standard design manufactured by a pipe hanger component manufacturer.

a. Steel pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or approved equal, with insulation shield.

b. Steel pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or approved equal.

12. Cast and ductile iron pipe - shall be B-Line B3148 NS, Grinnell Fig. 103, or approved equal.

a. Copper pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or approved equal, with insulation shield.

b. Copper pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or approved equal, lined with dielectric material.

c. Plastic pipe - shall be B-Line B3148, Grinnell Fig. 103, or approved equal.

d. Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe.

13. TYPE 12 - RISER CLAMP: Riser clamp shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 8.

a. Steel pipe (insulated) - shall be B-Line B3373, Grinnell Fig. 261, or approved equal.

b. Steel pipe (uninsulated) - shall be B-Line B3373, Grinnell Fig. 261, or approved equal.

c. Cast and ductile iron pipe - shall be B-Line B3373, Grinnell Fig. 261, or approved equal.

d. Copper pipe (insulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Michigan model 511, or approved equal.

e. Copper pipe (uninsulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Erico Caddy model 511, or approved equal.

f. Plastic pipe - shall be B-Line B3373, Grinnell Fig. 261c, or approved equal.

14. TYPE 13 - FRAMING CHANNEL PIPE STRAP: Pipe strap shall be carbon steel, with configuration equivalent to MSS Type 26.

a. Steel pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or approved equal.

b. Steel pipe (insulated) - shall be Superstrut No. C 708-U, Powerstrut PS 3126, Kin-Line No. 477, or approved equal, with insulation shield.

c. Copper pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, or approved equal, with insulation shield or lined with dielectric material.

d. Copper pipe (insulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, or approved equal, with insulation shield.

e. Plastic pipe - shall be Superstrut No. C-708-U, Powerstrut PS 3126, or approved equal.

C. Rack and Trapeze Supports:

1. General: Unless otherwise specified, trapeze and pipe rack components shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.

2. TYPE 20 - TRAPEZE PIPE SUPPORT: Trapeze pipe support cross members shall be framing channel as specified in this Section. Flat plate fittings shall be 1 5/8-inch square carbon steel of standard design manufactured by framing channel manufacturer, Unistrut P2471, B-Line B202-2, or approved equal.

3. TYPE 21 - PIPE RACK SUPPORT: Post and cross members shall be framing channel as specified in Article 2.2.E.5 of this section. Pipe rack fittings shall be carbon steel, of standard design manufactured by framing channel manufacturer. 90 degree fittings shall be gusseted Unistrut P2484, B-Line B844, or approved equal. Post base fittings shall be as specified in this section.

D. Structural Attachments:

1. TYPE A - MALLEABLE IRON CONCRETE INSERT: Concrete inserts shall be malleable iron and comply with MSS and FEDSPEC Type 18. Grinnell Fig. 282, Carpenter & Patterson Fig. 108, or approved equal.

2. TYPE B - SIDE BEAM BRACKET: Bracket shall be malleable iron and comply with MSS Type 34 and FEDSPEC Type 35. Grinnell Fig. 202, B-Line B3062, or approved equal.

3. TYPE C - MALLEABLE BEAM CLAMP WITH EXTENSION PIECE: Clamp and extension piece shall be malleable iron, tie rod shall be steel. Beam clamp shall comply with MSS and FEDSPEC Type 30. Grinnell Fig. 218 with Fig. 157 extension piece, B-Line B3054, or approved equal.

4. TYPE D - STEEL BEAM CLAMP WITH EYE NUT: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or approved equal.

5. TYPE E - FRAMING CHANNEL POST BASE: Post bases shall be carbon steel, of standard design manufactured by framing channel manufacturer.

a. Single channel: Unistrut P2072A, B-Line B280, or approved equal.

b. Double channel: Unistrut P2073A, B-Line B281, or approved equal.

6. TYPE F - WELDED BEAM ATTACHMENT: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or approved equal.

7. TYPE G - WELDED STEEL BRACKET: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.

8. TYPE H - CAST IRON BRACKET: Bracket shall be cast iron, Carpenter & Patterson Fig. 340, or approved equal.

9. TYPE J - ADJUSTABLE BEAM ATTACHMENT: Beam attachment shall be carbon steel, Carpenter & Patterson Fig. 151, B-Line B3082, or approved equal.

10. TYPE K - DOUBLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in this Section. Cantilever bracket shall be a carbon steel double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or approved equal.

11. TYPE L - SINGLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in Article 2.2.E.5 of this section. Cantilever bracket shall be a carbon steel single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or approved equal.

12. TYPE M - WALL MOUNTED CHANNEL: Wall channel shall be single channel framing channel as specified in Article 2.2.E.5 of this section.

13. TYPE N - PIPE STANCHION FLOOR ATTACHMENT: Baseplate shall be carbon steel with 1/2 inch minimum thickness. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with nonshrink grout.

E. Accessories:

1. HANGER RODS: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.

2. WELDLESS EYE NUT: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B3200, or approved equal.

3. WELDED EYE ROD: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B3211, or approved equal.

4. TURNBUCKLE: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 13. Turnbuckle shall be Grinnell Fig. 230, B-Line B3202, or approved equal.

5. FRAMING CHANNEL: Framing channel shall be 1 5/8 inches square, roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges.

a. Single channel: Unistrut P1000, B-Line B22, or approved equal.

b. Double channel: Unistrut P1001, B-Line B22A, or approved equal.

c. Triple channel: Unistrut P1004A, B-Line B22X, or approved equal.

2.03 THERMAL PIPE HANGER SHIELD

A. Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. The thermal shield shall be the same thickness as the piping system insulation. The standard shield shall be used for hot systems and the vapor barrier shield shall be used for cold systems. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.

B. Standard Shield:

a. Insulation:

1) Hydrous calcium silicate, high density, waterproof.

2) Compressive strength: 100 psi average.

3) Flexural strength: 75 psi average.

4) K factor: 0.38 at 100 degrees F mean.

5) Temperature range: 20 degrees F to 500 degrees F.

b. Steel Jacket: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.

c. Connection: Shield shall have butt connection to pipe insulation. Steel jacket and insulation shall be flush with end.

2. Vapor Barrier Shield:

a. Insulation:

1) Hydrous calcium silicate, high density, waterproof.

2) Compressive strength: 100 psi average.

3) Flexural strength: 75 psi average.

4) K factor: 0.38 at 100 degrees F mean.

5) Temperature range: 20 degrees F to 500 degrees F.

b. Steel Jacket: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.

c. Connection: Shield shall have butt connection to pipe insulation. Insulation shall extend 1 inch each side of steel jacket for vapor-tight connection to pipe insulation vapor barrier.

2.04 PRODUCT DATA

A. Hanger and support locations and components shall be indicated on the piping layout shop drawings.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

A. Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project manual to support continuous pipeline runs unaffected by concentrated loads.

B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.

C. Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

D. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.

E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.02 INSTALLATION

A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.

B. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

C. Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

D. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.

E. Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.

F. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

G. Rollers shall roll freely without binding.

H. Finished floor beneath Type N structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.

I. Baseplates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

J. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.03 ADJUSTMENTS

A. Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their baseplates.

3.04 FIELD FINISHING

A. Paint atmospheric exposed surfaces of galvanized steel components as specified in Section 09 96 00 - Painting.

END OF SECTION

SECTION 40 05 53
PROCESS VALVES

PART 1 GENERAL

1.01 SUMMARY

A. This Section specifies manual and automatic valves with accessories.

1.02 RELATED SECTIONS

A. Section 01 33 00 - Submittal Procedures

B. Section 40 05 51 - Common Requirements for Process Valves

1.03 REFERENCE STANDARDS

A. This Section contains references to the following documents. They are a part of this Section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this Section as if referenced directly. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

C. Relevant Standards:

1. ASME B1.1 - Pipe Threads, General Purpose (Inch)
2. ASME B16.1
3. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS
4. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded
5. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
6. ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500
7. ASME B16.25 - Buttwelding Ends
8. ASME B31.1 - Power Piping
9. ASME B31.9 - Building Services Piping
10. ASSE 1011 - Performance Requirements for Hose Connection
11. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes
12. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
13. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings
14. AWWA C111/A21.11- Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
15. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
16. AWWA C504 - Rubber-Seated Butterfly Valves

17. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS
18. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
19. AWWA C510 - Double Check-Valve Backflow Prevention Assembly
20. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly
21. AWWA C540 - Power-Actuating Devices for Valves and Slide Gates.
22. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
23. AWWA C606 - Grooved and Shouldered Joints
24. MSS SP-6 - Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
25. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions
26. MSS SP-42 - Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
27. MSS SP-45 - Drain and Bypass Connections
28. MSS SP-53 - Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
29. MSS SP-54 - Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components-Radiographic Examination Method
30. MSS SP-55 - Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components-Visual Method for Evaluation of Surface Irregularities
31. MSS SP-61 - Pressure Testing of Steel Valves.
32. MSS SP-67 - Butterfly Valves
33. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends
34. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends
35. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service
36. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends
37. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves
38. MSS SP 81 - Stainless Steel, Bonnetless, Flanged Knife Gate Valves
39. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded
40. MSS SP-86 - Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
41. MSS SP-88 - Diaphragm Valves
42. MSS SP-91 - Guidelines for Manual Operation of Valves
43. MSS SP-92 - MSS Valve User Guide
44. MSS SP-93 - Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components-Liquid Penetrant Examination Method
45. MSS SP-94 - Quality Standard for Ferritic and Martensitic Castings for Valves, Flanges, and Fittings and Other Piping Components-Ultrasonic Examination Method

1.04 SUBMITTALS

A. Submit the following items under provisions of Section 01 33 00 - Submittal Procedures:

1. Shop Drawings:
    a. Product data sheets for make and model.
    b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
    c. Power and control wiring diagrams, including terminals and numbers.
    d. Complete motor nameplate data.
    e. Open/close and throttle actuators sizing calculations.
    f. Valve pressure and temperature rating.
2. Quality Control:
    a. Certificate of Compliance for:
        1) Electric operators; full compliance with AWWA C540, as required.
        2) Butterfly valves; full compliance with AWWA C504, as required.
    b. Tests and inspection data.
    c. Manufacturer's Certificate of Proper Installation.
3. Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.01 GENERAL

A. Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.

B. Valve to be suitable for intended service. Renewable parts shall not be of a lower quality than specified.

C. Valve same size as adjoining pipe unless otherwise noted.

D. Valve ends to suit adjacent piping.

E. Size operator to operate valve for the full range of pressures and velocities.

F. Valve to open by turning counterclockwise.

G. Factory mount operator, actuator, and accessories.

2.02 SCHEDULE

A. Requirements relative to this Section are shown on the Valve Schedules as shown on the Contract Drawings.

2.03 MATERIALS

A. Brass and bronze valve components and accessories that have surfaces in contact with water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.
    1. Stainless steel 304 may be substituted for bronze.

B. Approved alloys are of the following:
    1. ASTM B61
    2. ASTM B62
    3. ASTM B98/B98M (Alloy UNS No. C65100, C65500, or C66100)
    4. ASTM B127
    5. ASTM B139 (Alloy UNS No. C51000)

6. ASTM B164
7. ASTM B194
8. ASTM B584 (Alloy UNS No. C90300 or C94700)

C. Materials specified in this Section are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.04 FACTORY FINISHING

A. Epoxy lined cast iron body valves, including those that are buried, where specified:

1. In accordance with AWWA C550.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion bonded" epoxy.
3. Minimum 7 mil dry film thickness except where limited by valve operating tolerances.

2.05 BALL VALVES

A. PVC Ball Valve 2 Inches and Smaller:

1. Rated 150 psi at 73 degrees Fahrenheit, with ASTM D1784, Class 12454-B polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Teflon O ring stem seals. Wetted parts shall be chemically compatible with process fluid. Hand lever operator shall be equipped with a lockout feature capable of accepting a padlock where indicated in the valve schedule. Lock-out feature shall provide for locking lever operator in the open and in the closed position.
2. Electric actuators for shall be 115 VAC with thermally protected, reversing motor in NEMA 4X rated enclosure. Actuator shall include a position indicator and a manual override. Actuators shall be mounted to the valve in the factory and delivered as a unit. Provide second set of valve position limit switches to be used for indication to the control system which shall not share control wiring or functions internal to the valve actuator.
3. Manufacturers:
    a. Nibco; Tru-Bloc
    b. Asahi/America
    c. Hayward Tru Union
    d. Spears
    e. Engineer approved equal

B. PVC Ball Valve 3 Inches and Larger:

1. Rated 150 psi at 73 degrees Fahrenheit, with ASTM D1784 Class 12454-B polyvinyl chloride full port body, Teflon seat, EDPM O ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1. All wetted parts shall be chemically compatible with process fluid. Hand lever operator shall be equipped with a lockout feature capable of accepting a padlock where indicated in the valve schedule. Lock-out feature shall provide for locking lever operator in the open and in the closed position.
2. Electric actuators for shall be 115 VAC with thermally protected, reversing motor in NEMA 4X rated enclosure. Actuator shall include a position indicator and a manual override. Actuators shall be mounted to the valve in the factory and delivered as a unit. Provide second set of valve position limit switches to be used for indication to the control system

which shall not share control wiring or functions internal to the valve actuator. Actuators shall be manufactured by Nibco, Asahi/America, Hayward, Spears, or approved equal.

3. Manufacturers:
    a. Nibco.
    b. Asahi/America.
    c. Hayward Tru Union.
    d. Spears.
    e. Engineer-approved equal.

2.06 PLUG VALVES

A. Eccentric Plug Valve:

1. Full-port resilient plug type suitable for drip tight, bi-directional shutoff at the rated pressure. Port areas for the valve shall be at least 100 percent of the adjacent full pipe area. Valve body shall be ASTM A126, Class B cast iron. Plug shall be ASTM A126, Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron. Valve shall have flanged ends with diameter and drilling in accordance with ASME B16.1, Class 125. Plug facing shall be Neoprene or Buna-N. Stem seal shall be V-type packing of at least four chevron type packing rings or U-cups, Buna-N or TFE. Body seats shall be Stainless Steel, ASTM A276/A276M, Type 304 or nickel. Valve body seats consisting of nickel for valves 3 inches and larger shall be constructed of a welded-in overlay of not less than 90 percent pure nickel. Upper and lower journal bearings shall be replaceable, sleeve-type, corrosion resistant, and permanently lubricated. Packing shall be self-adjusting chevron type replaceable without disassembling the valve.
2. Unless otherwise specified, valves 4 inches and smaller shall be provided with a lever type manual operator. Valves larger than 4 inches shall be provided with totally enclosed worm gear operators with handwheel. Where specified, manual operators shall have an adjustable stop. All operator components shall be sized for the valve design pressure in accordance with AWWA C504, Section 4.5.
3. Valves shall be provided with grease fittings on upper and lower bearing journals. Both upper and lower journals shall be protected by grit excluding seals. A bracket with windows of the same material as the valve body shall be provided to allow visual inspection of the shaft seals for leakage and manual adjustment. The bracket shall create an air gap between the valve bonnet and the gearbox to eliminate any possible seal leakage from entering the gearbox.
4. Interior surfaces shall be shop painted with the manufacturer’s standard epoxy to a minimum dry film thickness of 10 mils. Exterior surfaces shall be shop painted with the manufacturer’s standard primer to a minimum dry film thickness of 3 mils and field coated in accordance with Section 09 96 00 - High-Performance Coatings.
5. Manufacturers:
    a. DeZurik
    b. Valmatic
    c. Crispin
    d. Pratt
    e. Engineer approved equal

2.07 CHECK VALVES

A. PVC Ball Check Valve 4 Inches and Smaller:

1. Polyvinyl chloride body, single or dual union socket weld ends, rated 150 psi at 70 degrees F for valves up to 2” and 100 psi at 70 degrees for valves greater than 2”. Seat and seal to be EPDM or PTFE and chemically compatible with the process fluid.
2. Manufacturers:
    a. Asahi/America
    b. Nibco Chemtrol
    c. Spears
    d. Engineer-approved equal

B. Swing Check Valves 4 Inches and Larger:

1. Cast or ductile iron body, flanged ends, meeting the requirements of AWWA C508. Valves shall be full bronze mounted with elastomeric seating ring, single balanced disc, hinged at the top, outside lever and weight, waterway equal in area to connecting pipe. Hinge pins to be stainless steel.
2. Manufacturers:
    a. Dezurik
    b. Valmatic
    c. Crispin
    d. Golden Anderson
    e. M&H Valve Company
    f. Engineer-approved equal

2.08 GATE VALVES

A. Gate valves shall be designed for 150 psi working pressure and meet the requirements of AWWA C500 with installation position as shown on Contract Drawings. Connections shall be flanged for inside valves and mechanical joint for exterior ground-buried valves. Gate valves shall be cast iron body, fully bronze mounted, bronze stem, O-ring stem seal, non-rising stem and shall be double-disc parallel seat type. Gate valves 14 inches and larger when installed in a horizontal line in horizontal position shall be provided with rollers, tracks and scrapers and, when installed horizontally in a vertical line, shall also include slides. Gate valves shall have a clear waterway equivalent in area, when open, equal to that of the connecting pipe. The direction shall be indicated by an arrow cast into the valve. Where noted on Valve Schedule, valves with bypasses shall be provided.

1. Manufacturers:
    a. Clow
    b. Kennedy
    c. M&H Valve Company
    d. Engineer-approved equal

2.09 THERMO PLASTIC AIR RELEASE VALVES

A. Air release valves shall be normally open when the system is not under pressure. As the system is pressurized, gas within the system shall be expelled by the air release valves until liquid reaches the valve. When liquid reaches the valve, a poppet within the valve shall rise to create a bubble tight seal. When pressure and liquid level drop, the valve shall automatically re-open.

B. Valve body shall be PVC or CPVC to match adjacent piping. Valve shall be straight pattern with threaded inlet and outlet, and EPDM seals and seats for all services except polymer; Viton for polymer service.

C. Valve shall require a maximum of 10 psi for bubble tight seal with EPDM, 20 psi with Viton.

D. Pressure rating: 150 psi minimum

E. Manufacturers:

1. Model ARV by Plast-O-Matic
2. Engineer-approved equal

2.10 MANUAL OPERATORS

A. General:

1. Operator force not to exceed 40 foot-pounds under any operating condition, including initial breakaway. Provide gear reduction operator when force exceeds 40 pounds.
2. Operator self-locking type or equipped with self-locking device.

B. Position indicator on quarter-turn valves.

1. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.

C. Exposed Operator:

1. Galvanized and painted handwheels.
2. Lever operators allowed on quarter-turn valves 8 inches and smaller.
3. Cranks on gear type operators.
4. Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
5. Valve handles to take a padlock and wheels a chain and padlock.

2.11 ACCESSORIES

A. Limit Switch:

1. Factory installed limit switch by actuator manufacturer.

B. T Handled Operating Wrench:

1. One (1) each galvanized operating wrenches, 4 feet long for every ten (10) valves listed on the VALVE SCHEDULE with such operating wrench.
2. Manufacturers:
    a. Mueller; No. A24610.
    b. Clow No.; F2520.
3. One (1) each galvanized operating keys for cross handled valves for every ten (10) valves listed on the Valve Schedule shown in the Contract Drawings with such operating wrench.

C. Extension Bonnet for Valve Operator: Complete with stem and accessories for valve and operator.

1. Manufacturers:
    a. Pratt
    b. Allis-Chalmers

c. Engineer-approved equal

D. Chain Wheel and Guide:

1. Handwheel direct-mount type.
2. Complete with chain.
3. Galvanized or cadmium-plated.
4. Manufacturers:
   a. Clow Corp.; Figure F5680.
   b. Walworth Co.; Figure 804.
   c. DeZurik Corp.; Series W or LWG.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

C. Valve Orientation:

1. Except for plug valves as modified by (3) below;
   a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.
   b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.
2. Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.
3. Plug valves shall be oriented as follows, unless otherwise specified:
   a. Horizontal Flow: The flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve (stem horizontal).
   b. Vertical Flow: Install seat in the highest portion of the valve.
4. Install a line size ball valve and union upstream of each solenoid valve, in line flow switch, or other in line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
5. Install safety isolation valves on compressed air and fuel oil.
6. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.
7. Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3 feet below grade, furnish an operating extension stem with 2 inch operating nut to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover.

8. Torque Tube: Where operator for quarter-turn valve is located on floor stand, furnish extension stem torque tube of a type properly sized for maximum torque capacity of the valve.
9. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.
10. Chain Wheel and Guide: Install chain wheel and guide assemblies or chain lever assemblies on manually operated valves over 6 feet 9 inches above finished floor. Where chains hang in normally traveled areas, use appropriate "L" type tie-back anchors.

3.02 PAINTING

A. In accordance with Section 09 96 00.

B. Safety isolation valves and lockout valves with handles, handwheels, or chainwheels:

1. Safety Yellow.

C. Valve Testing:

1. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve applications.
2. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
3. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.
4. Set, verify, and record set pressures for all relief and regulating valves.
5. Automatic valve to be tested in conjunction with control system testing.

3.03 MANUFACTURER'S FIELD SERVICES

A. Manufacturer’s representative shall provide experienced onsite services as required to provide Manufacturer’s Certification of Proper Installation, assist the Contractor in the equipment delivery, storage, and installation, and supervise commissioning of the furnished equipment and performance of all testing requirements. Refer to Section 01 81 00 - Commissioning of Systems .

END OF SECTION

SECTION 40 23 00
PROCESS PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes process piping systems complete with pipe, fittings, connections, and accessories as indicated on the Pipe Schedule at the end of this Section or shown on the Drawings, for a complete and functioning installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 - Cast-in-Place Concrete

B. Section 05 50 00 - Metal Fabrications

C. Section 09 96 00 - Industrial Paints and Coatings

D. Section 31 23 33 - Trenching and Backfilling

E. Section 40 05 07 - Pipe Hangers and Supports

F. Section 40 05 53 - Process Valves

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. ANSI - American National Standards Institute
2. ASME - American Society of Mechanical Engineers
3. ASTM - American Society for Testing and Materials
4. AWWA - American Water Works Association
5. NCPWB - National Certified Pipe Welding Bureau
6. NEMA - National Electrical Manufacturers' Association
7. UL - Underwriters Laboratories

1.04 SYSTEM DESCRIPTION

A. General: Drawings show general arrangement, direction, and sizes of pipes. Drawings are not intended to show every offset and fitting or every structural difficulty that may be encountered. Install the piping and appurtenances to suit, and to avoid interference with installation, operation, and maintenance of fixtures, equipment, or other piping. Verify all measurements at job site.

B. Provide all piping with necessary hangers, anchors, and supports as specified herein and as indicated. Piping supported by equipment to which it is connected is not acceptable.

1.05 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings as required in Section 01 33 00 - Submittal Procedures, showing the layout of all process piping systems complete with piping, supports, and structural dimensions. Shop drawings shall identify all joints, valves, fittings, component parts, pipe material, insulation where required, and valve identification codes. Supports and anchors shall be shown in the layout and detailed.
2. Contractor shall verify in the field, the location, position, and size of all existing piping (including buried pipes), as indicated on the Contract Drawings and Specification to be reused, forming a part of the new process piping layout.

3. Process piping Shop Drawings submitted to the Engineer for review shall clearly indicate the location, position (elevation), and size of all existing piping to be reused.

B. Product Data:

1. Submit product data as required in Section 01 33 00 - Submittal Procedures. Include manufacturer's recommendations for installation, connection to automatic operators, and instructions for proper operation and maintenance. Valve operator data shall also include information necessary for any external controls, wiring hydraulics or pneumatics to be furnished, installed or connected by other Work.

C. Welders Certification:

1. Submit certification of welders and/or welding process for fabrication and/or field assembly.

D. Operation and Maintenance Data:

1. Submit operation and maintenance data as required in Section 01 77 00 - Closeout Procedures.

E. Record Drawings:

1. Submit record drawings as required in Section 01 77 00 - Closeout Procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling: Piping, valves and special castings shall at all times be handled in such a manner as to avoid any damage to pipe or specials. In the event pipe coating is damaged, especially on the inside of the piping, the damaged area shall be cleaned by wire brushing and then recoated with an approved coating similar to that specified for the pipe.

B. Storage: Store materials in enclosures or under protective coverings. Keep inside of pipe fittings and valves free of dirt and debris. Store in a manner for easy identification of all materials.

1.07 JOB CONDITIONS

A. Supply sleeves, supports, anchors or other items that are to be installed by other trades. Information for positioning the above items shall also be provided.

PART 2 PRODUCTS

2.01 PIPE SYSTEM

A. General:

1. Pipe systems shall conform to the materials or component performance as specified herein and the pipe schedule as shown on the drawings.

B. Ductile Iron Pipe Systems:

1. General: Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of the specified diameters, dimensions, and standards for a period of not less than 10 years. Testing of pipe required by AWWA C151/A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).

2. Pipe:

a. Buried Liquid Service Using Push-on, Mechanical, or Proprietary Restrained Joints: AWWA C111/A21.11, and AWWA C151/A21.51, pressure class conforming to Table 5 and Table 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron.

b. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.

3. Lining: AWWA C104 cement mortar.

4. Coating:

   a. Exposed: In accordance with Section 09 96 00 - Industrial Paints and Coatings.

   b. Buried: Asphaltic type, 1 mil thick, in accordance with AWWA C110/A21.10, AWWA C115/A21.15, AWWA C151/A21.51, and AWWA C153/A21.53 .

5. Connections:

   a. Push-on, compression gasket type conforming to AWWA C111/A21.11, 250 psi minimum working pressure, with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section. Push-on joints shall be installed with retainer-type glands unless otherwise approved by the Engineer. Gaskets shall be halogenated butyl or EPDM, Shore A hardness durometer 60, conforming to AWWA C111/A21.11.

   b. Flanges: Minimum pressure rating of 250 psi with Class 125 flat face, ductile iron, threaded conforming to AWWA C115/A21.15. Gaskets shall be 1/8-inch-thick, inorganic aramid fiber with nitrile binder, Shore A hardness durometer 80, rated to 275 degrees F, conforming to ASME B16.21, and shall be Toruseal by American Pipe or approved equal, suitable for a flanged connection rating of 350 psi. Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange Bolting shall be ASTM A307, Grade A carbon steel hex head bolts, ASTM A563/A563M, Grade A carbon steel hex head nuts and ASTM F436/F436M hardened steel washers at nuts and bolt heads. Bolting in wet wells or where shown shall be Type 316 stainless steel, ASTM A320/A320M, Grade B8M hex head bolts; ASTM A194/A194M, Grade 8M hex nuts and ASTM F436/F436M, Type 3 alloy washers at nuts and bolt heads.

   c. Mechanical: 250 psi minimum working pressure. Buried mechanical joints shall be restrained. Exposed bolting shall be manufacturer’s standard, unless otherwise noted. Buried bolting shall be Type 316 stainless steel. Gaskets shall be halogenated butyl or EPDM, Shore A hardness durometer 60, conforming to AWWA C111/A21.11.

   d. Proprietary Restrained: 150 psi minimum working pressure. McWane, Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Bolting shall be manufacturer’s standard, unless otherwise noted. Gaskets shall be halogenated butyl or EPDM, Shore A hardness durometer 60, conforming to AWWA C111/A21.11.

   e. Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure; Victaulic. Bolting shall be manufacturer’s standard, unless otherwise noted. Gaskets shall be halogenated butyl conforming to ASTM D2000 and AWWA C606.

6. Couplings:

   a. Grooved End: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.

7. Fittings:

   a. AWWA C110/A21.10 and AWWA C111/A21.11 with lining, coating, and pressure rating same as pipe.

   b. Push-on: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint; or approved equal.

c. Mechanical: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Follower glands shall be ductile iron.

d. Proprietary Restrained: AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Restraint shall be achieved with removable metal elements fitted between a welded bar on the pipe barrel and the inside of the joint bell or fitting sizes smaller than 16 inches may be mechanical joint, restrained by anchor gland followers, ductile iron anchor type, wedge action, with break-off tightening bolts. Assembled joints shall be rated for deflection in operation at rated pressure. Rated deflection shall be not less than 1-1/2 degrees for 36-inch and smaller pipe. Rated deflection shall be not less than 1/2 degree for 42-inch and larger pipe. McWane., American Cast Iron Pipe Co., U.S. Pipe, or approved equal. Restrained joints relying on metal teeth molded into the gasket to prevent joint separation under pressure will not be accepted.

e. Grooved End: AWWA C606 and AWWA C110/A21.10, ductile iron, 250 psi minimum working pressure; Victaulic.

f. Flanges shall be AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face or ASME B16.1, Class 250 raised face.

C. Copper Pipe Systems:

1. Pipe: Conform to ASTM B88, Type L

2. Connections: Copper Sweat or Compression

3. Fittings: Conform to ASME B16.18 or ASME B16.22.

D. Steel Pipe Systems:

1. Black carbon steel, ASTM A106/A106M, Grade B seamless or ASTM A53/A53M, Grade B seamless or ERW. Threaded, butt-welded, grooved end, and flanged joints:

a. Screwed:

1) 2" & smaller: Schedule 40.

b. Welded:

1) 2-1/2" thru 10": Schedule 40.

2) 12" thru 16": Schedule 30.

3) 18" thru 24": Schedule 20.

2. Grooved:

1) 2-1/2" thru 6": Schedule 40.

2) 8" thru 12": Schedule 30.

3) 14": Standard weight.

3. Joints:

a. 2" & smaller: Threaded or flanged at valves and equipment or grooved end meeting the requirements of AWWA C606.

b. 2 1/2" & larger: Butt-welded or flanged at valves and equipment, or grooved end meeting the requirements of AWWA C606.

4. Fittings:

a. 2" & smaller:

1) Threaded: 150 or 300 pound malleable iron, ASTM A197/A197M or ASTM A47/A47M, dimensions in accordance with ASME B16.3.

2) Grooved End: Malleable iron ASTM A47/A47M or ductile iron ASTM A536, grooved ends to accept couplings without field preparation. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products.

b. 2 1/2" & larger:

1) Butt Welded: Wrought carbon steel butt- welding, ASTM A234/A234M A, Grade WPB meeting the requirements of ASME B16.9; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.

2) Grooved End: Malleable iron ASTM A47/A47M, ductile iron ASTM A536, forged steel ASTM A234/A234M, or factory fabricated from ASTM A53/A53M pipe. Grooved ends to accept couplings without field preparation. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products.

5. Branch Connections:

6. 2" & smaller: For threaded pipe, threaded, straight, or reducing tees in conformance with Fittings specified above. For welded or grooved pipe, use threadolet.

a. 2 1/2" & larger: Butt-welding or grooved end tee in conformance with Fittings specified above.

7. Flanges:

a. 2" & smaller:

1) Forged carbon steel, ASTM A105/A105M, Grade II, ASME B16.5 Class 150 or Class 300 socket-weld or threaded, 1/16 inch raised face.

b. 2 1/2" & larger:

1) Butt-Welded Systems: Forged carbon steel, ASTM A105/A105M, ASME B16.5 Class 150 or Class 300 slip-on or welding neck, 1/16 inch raised face; weld neck bore to match pipe internal diameter. Use weld neck flanges when abutting butt-weld fittings. Weld slip-on flanges inside and outside.

2) Grooved End Adapter Flange: Malleable iron ASTM A47/A47M or ductile iron ASTM A536. Victaulic Style 741 or 743; Anvil International, Inc., Gruvlok Figure 7012 or 7013; Shurjoint Model 7041 A. Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.

3) Cast Iron Mating Flange: ASTM C207, Class D or E, hub or ring type to mate with ASME B16.1 Class 125 cast-iron flange. ASTM C207 Class F hub type or ASTM A105/A105M, ASME B16.5 Class 300 to mate with ASME B16.1 Class 250 cast-iron flange.

8. Unions:

a. 2" & smaller: Threaded malleable iron, ASTM A197/A197M or ASTM A47/A47M, 150 or 300 pound WOG, meeting the requirements of ASME B16.3.

9. Couplings:

a. 2 1/2" & larger:

1) Grooved End: Rigid joint malleable iron, ASTM A47/A47M or ductile iron, ASTM A536. Victaulic Co.; Anvil International, Inc., Gruvlok; Shurjoint Piping Products.

2) Screwed End: Malleable iron, ASTM A197/A197M or ASTM A47/A47M.

b. Bolting:

c. Flanges: Carbon steel ASTM A307, Grade A hex head bolts; ASTM A563/A563M, Grade A hex head nuts and ASTM F436/F436M, hardened steel washers at nuts and bolt heads. When mating flange on equipment is cast iron and gasket is flat ring,

provide ASTM A307, Grade B hex head bolts; ASTM A563/A563M, Grade A heavy hex nuts and ASTM F436/F436M hardened steel washers at nuts and bolt heads.

d. Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 110,000 psi minimum tensile strength.

e. Flanged Joints in Sumps, Wet Wells, and Submerged and Wetted Installations: Type 316 stainless steel, ASTM A320/A320M, Grade B8M hex head bolts; ASTM A194/A194M, Grade 8M hex nuts and ASTM F436/F436M, Type 3 alloy washers at nuts and bolt heads.

10. Gaskets:

a. 1/8 inch-thick, compressed inorganic fiber with nitrile binder, rated 400 degrees F. continuous. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange. Grooved couplings shall have EPDM gaskets per ASTM D2000 to 230 degrees F.

2.02 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:

1. Diameter, Lining, and Ends: Same as connecting ductile iron pipe.
2. Thickness: Equal to or greater than remainder of pipe in line.
3. Fittings: In accordance with this specification.
4. Thrust Collars:

a. Rated for thrust load developed at 250 psi.

b. Safety Factor: 2, minimum.

c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.

5. Manufacturers:

a. American Cast Iron Pipe Co.

b. U.S. Pipe and Foundry Co.

c. Engineer approved equal.

B. Steel or Stainless Steel Wall Pipe:

1. Same material and thickness as connecting pipe, except 1/4-inch minimum thickness.
2. Lining: Same as connecting pipe.
3. Thrust Collar:

a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.

b. Continuously fillet welded on each side all around.

2.03 PIPE SLEEVES

A. Sleeves shall be Schedule 40 pipe and be galvanized. Shop lining and coating in accordance with Section 09 96 00 - Industrial Paints and Coatings. Seep ring, center in wall in exterior or water bearing walls, 3 inches greater outside diameter than outside diameter of pipe, continuous fillet weld on each side all around.

B. Sleeves less than 12” diameter may be thermoplastic by Thunderline or approved equal.

2.04 MODULAR MECHANICAL SEALS

A. Modular mechanical seals shall be interlocking, expandable type of molded synthetic rubber segments with 304 stainless steel bolts and nuts and pressure plate.

B. Seals shall be as manufactured by Thunderline or approved equal.

2.05 COUPLINGS

A. General:

1. Coupling linings for use in potable water systems shall be in conformance with NSF 61.
2. Pressure rating at least equal to that of related pipeline and not less than 150 psi.
3. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with requirements of AWWA M11, or as shown on Drawings.

B. Mechanical Sleeve-Type Coupling:

1. Manufacturers and Products:
    a. Steel Pipe:
        1) Dresser Piping Specialties; Style 38.
        2) Smith-Blair, Inc.; Style 411.
        3) Romac; 400.
        4) Engineer approved equal.
    b. Ductile Iron Pipe:
        1) Dresser Piping Specialties; Style 38.
        2) Smith-Blair, Inc.; Style 441.
        3) Romac; 501.
        4) Engineer approved equal.

C. Flanged Coupling Adapter:

1. Anchor studs not acceptable.
2. Manufacturers and Products:
    a. Steel Pipe:
        1) Baker Coupling Products; Series 602.
        2) Dresser Piping Specialties; Style 128.
        3) Smith-Blair, Inc.; Style 913.
        4) Romac; FC400.
        5) Engineer approved equal.
3. Ductile Iron Pipe:
        1) Baker Coupling Products; Series 602.
        2) Dresser Piping Specialties; Style 128.
        3) Smith-Blair, Inc.; Style 912.
        4) Romac; FCA501.
        5) Engineer approved equal.

D. Restrained Flanged Coupling Adapter:

1. Pressure Rating:
    a. Minimum Working Pressure Rating: Not less than 150 psi.
    b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
2. Thrust Restraint:
    a. Provide hardened steel wedges that bear against and engage outer pipe surface and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
    b. Products employing set screws that bear directly on pipe will not be acceptable.
    c. Manufacturer and Product:
        1) EBAA Iron Sales Co.; 2100 Mega Flange.
        2) Romac; RFCA
    d. Smith-Blair, Inc.; Style 911.
        1) Engineer approved equal.

E. Grooved End Couplings:
1. Flexible-Type Couplings: For piping greater than 12-inches in diameter; for piping 12-inches in diameter and less in rack-mounted tunnel piping; and for grooved joints adjacent to pump or blower suction and discharge. Manufactured by Victaulic, Style 77, or approved equal.
2. Rigid-Type Couplings: All other applications for piping 12 inches in diameter and less that do not require flexible-type couplings. Manufacturer by Victaulic, Style 07 Zero-Flex; or approved equal.
3. Cut grooves are not permitted on fabricated or lightwall pipe.
4. Hardware: Comply with AWWA C606. For submerged service, Type 316 stainless steel. For buried service, corrosion resistant, high strength, low alloy steel, per AWWA C111/A21.11, regardless of protective coating.

2.06 MISCELLANEOUS SPECIALTIES

A. Strainers, Bronze, Water Service, 2-inches and Smaller:
1. Type: Bronze body, Y pattern, 200 psi non-shock rated, with screwed gasketed bronze cap.
2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20 mesh.
3. Manufacturers and Products:
    a. Armstrong International, Inc.; Model F.
    b. Mueller Steam Specialty; Model 351M.

B. Strainers, Stainless Steel, Water Service, 2 Inches and Smaller:
1. Type: Cast stainless steel body, Y-pattern, Class 600, screwed ends, with screwed gasketed stainless steel cap.
2. Screen: Heavy-gauge Type 304 stainless steel, 0.062 perf opening.
3. Manufacturer and Products:
    a. Armstrong International, Inc.; E Series.
    b. Mueller Steam Specialty; Model 581-SS/861-SS.

C. Hose Coupling, 1-inch and Smaller:

1. Type: Brass or malleable iron, female threaded end, NBR seal, 40 mm lug distance, working pressure 16 bar, twist-claw coupling for water hoses furnished with matching clamps.

2. Manufacturer and Products:

a. Grainger; Chicago-Style Universal Coupling

b. McMaster-Carr; Twist-Claw Hose Coupling, Series 5344K

2.07 PIPE INSULATION

A. In accordance with Section 22 07 19, Plumbing Piping Insulation.

2.08 PIPE CORROSION PROTECTION

A. Coatings: See Section 09 96 00 - Industrial Paints and Coatings, for details of coating requirements.

B. Insulating Flanges, Couplings, and Unions:

1. Materials:

a. In accordance with applicable piping material specified. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline.

b. Galvanically compatible with piping.

c. Resistant for intended exposure, operating temperatures, and products in pipeline.

2. Union Type, 2 Inches and Smaller:

a. Screwed or solder-joint.

b. O-ring sealed with molded and bonded insulation to body.

3. Flange Type, 2-1/2-inches and Larger:

a. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.

b. Bolt insulating sleeves shall be provided full length between insulating washers.

c. Ensure fit-up of components of insulated flange assembly to provide a complete functioning installation.

d. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves.

e. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of required washers, flanges, and gasket.

4. Flange Insulating Kits:

a. Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.

b. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).

c. Insulating Washers: Fiberglass-reinforced epoxy (NEMA LI-1, G-10 grade).

d. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.

1) Flange Diameters 36 Inches or Less: Provide two washers per bolt.

2) Flange Diameters Larger Than 36 Inches: Provide four washers per bolt.

5. Manufacturers and Products:
    a. Dielectric Flanges and Unions:
        1) PSI, Houston, TX.
        2) Advance Products and Systems, Lafayette, LA.
        3) Engineer approved equal.
    b. Insulating Couplings:
        1) Dresser; STAB-39.
        2) Baker Coupling Company, Inc.; Series 216.
        3) Engineer approved equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

A. Contractor shall field measure all dimensions and check possible interferences for the pipe system and accessories.

3.02 PREPARATION

A. Pipe fittings and accessories shall be free of all foreign matter. Accumulations of dirt, rust, scale, etc., shall be removed prior to installation. Pipe ends shall be reamed and deburred to prevent loose particles from getting into the pipe line.

3.03 INSTALLATION

A. General:
    1. Pipe systems shall be installed to line and grade indicated on the Plans. Valves shall be located as indicated on the Plans.
    2. Piping connections to equipment shall be aligned and supported in such manner that no load or thrust will be exerted upon the equipment by the piping at installation or in operating conditions.

B. Miscellaneous System Connections: Connections to large size pipe or headers for gages, sampler lines or other small inlets or outlets shall be made as indicated on the Plans and specified herein. Connections to large steel pipe shall be by welding on the threaded saddle. The small line shall be socket or nipple type for either threaded or welded connection. Tapping saddles shall be used on large PVC or fiberglass pipe. The small line connection shall be threaded. Connections shall have gate valve installed adjacent to pipe.

C. Painting: Pipe shall be painted. See Section 09 96 00 - Industrial Paints and Coatings, for information on painting, color schedule, identification and flow direction arrows.

3.04 COUPLINGS

A. General:
    1. Install in accordance with manufacturer’s written instructions.
    2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
    3. Do not remove pipe coating. If damaged, repair before joint is made.

B. Application:
    a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
    b. Concrete Encased Couplings: Flexible coupling.

3.05 PIPE SLEEVES

A. Application:

1. Above Grade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
2. Below Grade or in Submerged or Damp Environments: Shop-lined and coated.
3. Alternatively, Molded Polyethylene Pipe Sleeve as specified may be applied.

B. Installation:

1. Support noninsulating type securely in formwork to prevent contact with reinforcing steel and tie-wires.
2. Caulk joint with specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

3.06 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:

1. Watertight and Below Ground Penetrations:
    a. Wall pipes with thrust collars.
2. Provide taps for stud bolts in flanges to be set flush with wall face.
3. Nonwatertight Penetrations: Pipe sleeves with seep ring.
4. Existing Walls: Rotary drilled holes.
5. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09 96 00 - Industrial Paints and Coatings.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie-wires.

3.07 FIELD QUALITY CONTROL

A. General:

1. Installed pipe systems shall be tested by hydrostatic or pneumatic means as specified herein.
2. Hydrostatic testing shall be for any fluid type material to be handled with pneumatic testing for any gas, air, chemical, oil, or grease pressurized lines.
    a. Testing shall be made with the temperatures of surrounding air and test water or air are approximately constant within operating temperature ranges.
3. Pipe ends shall be valved or blanked off.
4. Exterior surfaces of pipes, fittings, or valves shall show no cracks or other forms of leakage.

B. Hydrostatic Testing for Pressure Piping:

1. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
2. Exposed Piping:
    a. Perform testing on installed piping prior to application of insulation.
    b. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.

c. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.

d. Maintain hydrostatic test pressure as indicated in the pipe schedule continuously for two hours, minimum, and for such additional time as necessary to conduct examinations for leakage.

e. Examine joints and connections for leakage.

f. Correct visible leakage and retest as specified. Lines shall be drop tight.

g. Empty pipe of water prior to final cleaning or disinfection.

C. Pneumatic Testing:

1. Do not perform on plastic pipe, pipe larger than 18 inches, or buried and other non-exposed piping.

2. Fluid: Oil-free, dry air.

3. Procedure:

a. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.

b. Correct visible leaks and repeat preliminary test until visible leaks are corrected.

c. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.

d. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.

e. Correct visible leakage and retest as specified.

4. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

D. Test Report Documentation:

1. Test date.

2. Description and identification of piping tested.

3. Test fluid.

4. Test pressure.

5. Remarks, including:

a. Leaks (type, location).

b. Repair/replacement performed to remedy excessive leakage.

6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 40 71 13
MAGNETIC FLOW METERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section describes the requirements for field-mount flow measuring and sensing Instruments, and associated devices and appurtenances. Under this Section, the Contractor shall furnish and install the specified equipment and accessories as indicated on the Plans and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 10 - Basic Electrical Materials and Methods

B. Section 26 05 53 - Electrical Identification

C. Section 26 07 05 - Electrical Testing and Equipment

D. Section 26 07 10 - Demonstration and Training

E. Section 26 09 00 - Instrumentation and Control for Electrical Systems - General

1.03 REGULATORY REQUIREMENTS AND REFERENCES

A. Conform to requirements of NFPA 70 National Electrical Code.

B. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.

C. Equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.

D. Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:

1. ANSI/ISA applicable standards for measurement and instrumentation.

2. NEMA ICS 1 - General Standards for Industrial Control Systems, NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies, and NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.04 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings as required in Sections 01 33 00.

2. Shop Drawings shall indicate electrical characteristics and connection requirements, including layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied. Provide Product Data showing manufacturer's specifications, electrical characteristics, and connection requirements for each Product supplied.

3. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or Product Testing Agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each Product supplied.

B. Operation and Maintenance Data:

1. Installation and Start-Up Requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.

2. Maintenance Data shall include component parts diagrams and Lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

C. Recording Drawings:

1. Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

1.05 DELIVERY, STORAGE AND HANDLING

A. 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.

2. Storage:

a. Store materials in enclosures or under protective coverings. Keep inside of pipe fittings and valves free of dirt and debris. Store in a manner for easy identification of all materials.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

1.07 PROJECT CONDITIONS

A. Instruments shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described hereinbelow. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.

B. Maintain instruments free of dirt and dust during and after installation.

1.08 WARRANTY

A. The manufacturer shall warrant the meter(s) to be free from defects in materials and workmanship for one (1) year after installation.

1.09 SYSTEM DESCRIPTION

A. Electromagnetic flow meter is intended for fluid metering in potable water. No moving parts are in the flow stream. Transmitter will be remote-mounted. Unit will be ideally suited for measuring dynamic, non-continuous flow. In applications where a minimum and/or maximum flow rate must be tracked and monitored, the unit will provide pulse signals that can be fed to dedicated batch controllers, PLCs and other specified specialized instrumentation.

PART 2 PRODUCTS

2.01 MAGNETIC FLOWMETER SYSTEMS (FE/FTI)

A. Magnetic Flowmeters shall be as manufactured by ABB, Krohne, Rosemount, Endress & Hauser, Siemens or Badger Meter.

B. Each magnetic flowmeter system shall consist of a magnetic flowmeter (FE) and a flow transmitter indicator (FTI). The size of the meters and flow ranges shall be as shown on the Drawings.

C. Each magnetic flowmeter shall be of the DC type and shall be equipped with: tungsten carbide, stainless steel or platinum electrodes; copper magnetic coils; a lined stainless steel flow tube, with welded steel housing, and with ANSI Class 150 flanges on both ends; two metallic liner protectors, which shall serve as grounding rings; and, two ground straps. A wafer style body to mount between two ANSI Class 150 flanges and the two grounding rings shall be allowed for meters smaller than 6" in size.

D. The flow tube liner shall be: neoprene or polyurethane for wastewater or sludge streams; and, of PTFE for chemical streams. The electrodes and liner protectors shall be of material suitable for use with the liquid stream being measured.

E. 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 +/- 0.5% of rate of flow from 1FPS to 32FPS. The signal converter shall: be microprocessor based; have adjustable damping up to 90 sec/full scale response to 100% step change; provide full isolation of I/0; and maintain continuous zero stability.

F. The flow transmitter shall operate at 120 VAC and be housed in a remote mounted waterproof and splashproof enclosure for protection of electronic parts. A flow indicator calibrated in GPM, or other engineering units, as shown on the Drawings, shall also be provided.

G. If a flow indicator is not available integral to the flow transmitter, a remote flow indicator shall be provided as specified.

H. Magnetic flowmeters installed in below-grade locations shall be suitable for occasional submergence: 30 ft. for 72 hours (minimum). All necessary appurtenances (sealing fittings) for the field installation to meet this submergence requirement shall be included with the meter.

2.02 CALIBRATION

A. Each flow sensor, and each flow transmitter/indicator, shall be provided with a certified calibration traceable to NIST.

B. A copy of the manufacturer’s configuration software and any necessary cables shall be provided to the Owner, for use in calibrating the flow transmitter instruments. If software is not available, then two (2) handheld configurators shall be provided to the Owner.

PART 3 EXECUTION

3.01 VERIFICATION

A. Contractor shall field measure all dimensions and check possible interferences for the meter(s) and specified accessories.

3.02 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.

D. See Section 16195 for nameplate, circuit number marker, and wire marker, etc. requirements.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.04 MANUFACTURER'S FIELD SERVICES

A. Prepare, calibrate, and start systems under provisions of Section 26 08 00 - Calibration and Start-up of Systems.

B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings.

3.05 DEMONSTRATION

A. Demonstrate calibration and operation of devices.

B. Provide systems demonstration under provisions of Section 26 07 10 - Demonstration and Training.

C. After acceptance of the flow instrument equipment, the Owner's operators shall be provided with one-half day (minimum) of onsite training in the use and maintenance of each type of the equipment. The training shall cover the calibration of the flow instruments, preventative maintenance of all equipment, and troubleshooting and repair/replacement procedures.

3.06 SPARES

A. In addition to the installed equipment, as Specified above, and as shown on the Drawings, provide one spare of each type of transmitter-indicator, and one spare of each type of flow switch, each package, as indicated.

B. Turn over software, and all spares at the time of, and as a condition of, acceptance.

END OF SECTION

SECTION 40 72 00
LEVEL MEASUREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section describes the requirements for field-mount leveling measuring and sensing instruments, and associated devices and appurtenances. Under this Section, the Contractor shall furnish and install the specified equipment and accessories as indicated on the Plans and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 05 10 - Basic Electrical Materials and Methods

B. Section 26 05 53 - Electrical Identification

C. Section 26 07 05 - Electrical Testing and Equipment

D. Section 26 07 10 - Demonstration and Training

E. Section 26 09 00 - Instrumentation and Control for Electrical Systems - General

1.03 REGULATORY REQUIREMENTS AND REFERENCES

A. Conform to requirements of NFPA 70 National Electrical Code.

B. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.

C. Equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.

D. Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:

1. ANSI/ISA applicable standards for measurement and instrumentation.

2. NEMA ICS 1 - General Standards for Industrial Control Systems, NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies, and NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.04 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings as required in Sections 01 33 00.

2. Shop Drawings shall indicate electrical characteristics and connection requirements, including layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied. Provide Product Data showing manufacturer's specifications, electrical characteristics, and connection requirements for each Product supplied.

3. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or Product Testing Agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each Product supplied.

B. Operation and Maintenance Data:

1. Installation and Start-Up Requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.

2. Maintenance Data shall include component parts diagrams and Lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

C. Recording Drawings:

1. Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

1.05 DELIVERY, STORAGE AND HANDLING

A. 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.

2. Storage:

a. Store materials in enclosures or under protective coverings. Keep inside of pipe fittings and valves free of dirt and debris. Store in a manner for easy identification of all materials.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

1.07 PROJECT CONDITIONS

A. Instruments shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described herein. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.

B. Maintain instruments free of dirt and dust during and after installation.

1.08 WARRANTY

A. The manufacturer shall warrant the meter(s) to be free from defects in materials and workmanship for one (1) year after installation.

1.09 SYSTEM DESCRIPTION

A. Electromagnetic flow meter is intended for fluid metering in potable water. No moving parts are in the flow stream. Transmitter will be remote-mounted. Unit will be ideally suited for measuring dynamic, non-continuous flow. In applications where a minimum and/or maximum flow rate must be tracked and monitored, the unit will provide pulse signals that can be fed to dedicated batch controllers, PLCs and other specified specialized instrumentation.

PART 2 PRODUCTS

2.01 LEVEL TRANSMITTERS (RADAR TYPE)

A. Radar type level transmitters shall be as manufactured by Endress+Hauser, Micropilot Series FMR 20, Vega PULSWL61 or previously approved equal.

B. The level transmitters shall convert microwave electromagnetic pulse transit time into a 4-20 ma DC signal for level indication, recording, and other use as shown on the Drawings. The level transmitter shall measure level to within accuracy of +/- 0.3% of span and repeatability shall be +/- 0.1% of span. An integral indicator for reading output signal in 0 to 100%, or other scale as indicated on the Drawings, shall be provided for each level transmitter.

C. The level transmitter shall be suitable for operation in an environment with temperature ranging from 0 degrees C to 50 degrees C and relative humidity ranging from 0% to 95% (non-condensing). Sensors, and/or transmitter-indicators, shall be either intrinsically safe, or explosion proof, if located in areas classified as hazardous as shown on the Drawings. The level transmitter shall be suitable for operation in a closed or open tank of metallic or non-metallic construction, or in a stilling well, as indicated on the Drawings.

D. Each level transmitter shall be of the “smart” type with communications provided for configuration by remote handheld calibrator, or by configuration software, loaded onto Owner’s portable computer. The level transmitter-indicator shall be a PC-based, acoustic transit time type system, which shall utilize many discrete data samples to arrive at an average transit time. These transit time data points shall be integrated to determine the level.

E. The transmitter shall evaluate each acoustic signal received and shall reject those which are distorted by reflections or reverberations or whose amplitude is below minimum value, or other intelligent filtering criteria. Each travel time resulting from accepted signals shall be checked to ensure that the measured time is within user-selectable limits. Level and rate-of-change-of-level limits shall be user selectable and adjustable on-site.

F. The level transmitter-indicator shall have a alphanumeric keypad for user interface with the level transmitter. The user shall be able to enter all site-specific and operational parameters via the keypad. Parameter entry shall be aided by menu-driven, English language prompts on the unit display. The system shall also be capable of communication and set-up via a portable computer.

G. The transmitter-indicator unit shall be installed in a NEMA Type 4X enclosure suitable for wall mounting. The keypad and display shall be mounted inside the front of the enclosure and shall be accessible by opening the front of the enclosure. The keypad shall be equipped with a password protect function to prevent unauthorized access to the level transmitter set-up functions.

H. The transmitter-indicator shall be equipped with an EL or LCD-type level display. The system shall display any messages that indicate the type and of a signal interruption or transducer failure.

I. The level transmitter console shall have a self-test routine that periodically checks for proper operation of the level transmitter transceiver, processor, and timing functions. The system shall alert the user to any self-test or acoustic path failure by displaying an error message on the level transmitter display. The level transmitter shall also provide a message indicating the type of failure. The level transmitter shall be designed to return to full operation following a short-term power interruption, with all stored values retained.

J. A 4-20 mADC output of level shall be provided. The analog output shall be programmed to output 4 mADC if the level transmitter is in error mode. A ‘dry’ contact output (normally held open) shall indicate transmitter-indicator “trouble”. Provide dry contact closure control and alarm outputs as shown on the Drawing.

K. One RS-232C, RS-422, or RS-485 communications port shall be provided for set-up, and transmission of data.

L. A copy of the manufacturer’s configuration software, and any necessary cables and accessories, shall be provided to the Owner, for use in calibrating the transmitters. If software is not available, then two (2) handheld configurators shall be provided to the Owner.

M. Transducer Assemblies:

1. Transducers installed on the tanks shall be of the 6 inch, flange mount, piezoeletric type, unless otherwise indicated on the Drawings. Transducer assemblies shall be constructed of corrosion resistant materials suitable for the use intended, as shown on the Drawings.

2. Transducer cables shall be routed through raceways, and brought to a common penetration, exiting the raceway and routed to the level transmitter-indicator as shown on the Drawings.

N. Contractor shall furnish all cable between the transducers and the electronic console. The cable shall be the type of specified by the manufacturer. Any connectors to the transducers that may be required shall be supplied by the manufacturer.

2.02 FLOAT SWITCHES (NORMAL DUTY TYPE)

A. Pipe or chain mounted float switches shall be as manufactured by Consolidated Electric, a division of U.S. Filter (Siemens) Model LS with LSW1 weight kit or Anchor Scientific, Inc. “Rotofloat” Type SST series.

B. Cable weight kit shall be as manufactured by Consolidated Electric, a division of U.S. Filter (Siemens): Model No. CBM or equal.

C. Suspension mounted float switches shall be as manufactured by Conery Mfg Model B1 with C1 weight option with S.S. brackets, Consolidated Electric, a division of U.S. Filter (Siemens): Model No. CBM or Anchor Scientific, Inc. “Rotofloat” Type S.

D. Float switches shall be direct acting with 3-1/2 inch diameter, either normally open or normally closed non-mercury switch with polypropylene shell and solid polyurethane foam filling, and flexible 18/2 conductor cable with PVC jacket suitable for heavy flexing service. Cable lengths shall be as required.

E. Float switch contacts shall be rated 10 amps at 120 VAC.

F. Float switches shall be suitable for pipe or support chain mounting as shown on the Drawings.

G. Pipe mounted float switches shall be provided with a one-inch diameter stainless steel pipe, stainless steel or polypropylene float switch mounting clamps, pipe stabilization brackets, and all other necessary hardware.

H. Support chain mounted float switches shall be provided with a stainless steel support chain, PVC coated weight, and float switch mounting clips.

2.03 FLOAT SWITCHES (CHEMICAL DUTY TYPE)

A. Chemical and acid service float switches shall be as manufactured by Consolidated Electric Model LS or Anchor Scientific, Inc. “Rotofloat” Type P.

B. Float switches shall be heavy duty, industrial grade polypropylene float switches suitable for insertion in 30% sulfuric acid at 130° F and/or oil/water solutions. Float switch cables shall be three conductor flexible cable with PVC jacket suitable for use in the aforementioned solutions. Cable lengths shall be as required.

C. Float switch contacts shall be rated 5 amps at 120 VAC rating.

D. Float switches shall be suitable for pipe or suspension mounting as shown on the Drawings.

E. Pipe mounted float switches shall be provided with a one inch diameter, Schedule 40, plastic support pipe; polypropylene float switch mounting clamps with polypropylene screws; non-metallic pipe stabilization brackets; and all other necessary hardware.

F. Cable cord grip connectors shall be watertight, corrosion resistant, dust-tight, and oil-resistant.

G. The connectors shall be constructed of thermoplastic polyester material with nylon cord grip and neoprene bushing all sized to properly fit and seal around the float switch cable.

H. Cord grip connectors shall be as manufactured by Crouse-Hinds Type NCGB.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete and building interior is enclosed and heated.

C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.

D. See Section 26 05 53 - Electrical Identification for nameplate, circuit number marker, and wire marker, etc. requirements.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 26 07 05 - Electrical Testing and Equipment.

B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare, calibrate, and start systems under provisions of Section 26 08 00 - Calibration and Start-up of Systems.

B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings

3.04 DEMONSTRATION

A. Demonstrate calibration and operation of devices.

B. Provide systems demonstration under provisions of Section 26 07 10 - Demonstration and Training.

C. After acceptance of the level equipment, the Owner's operators shall be provided with one-half day (minimum) of onsite training in the use and maintenance of the equipment. The training shall cover the calibration of the level instruments, preventative maintenance of all equipment, and troubleshooting and repair/replacement procedures.

3.05 SPARES

A. In addition to the installed equipment, as Specified above, and as shown on the Drawings, provide one spare of each type of transmitter-indicator (or field replaceable module), and one spare primary element/sensor (complete with 30 feet of cable where the cable is integral to the sensor) or level/float switch, each packaged as indicated.

B. For sensors of the field rebuildable, or rechargeable type, provide rebuild, and/or recharge kits adequate to service all installed sensors.

C. Provide a calibration kit, with all necessary accessories, all packaged in a hard-side case, for each different type of sensor or transmitter. Each Kit shall be suitable for maintaining all installed instruments of that type in calibration, at the manufacturer's recommended maintenance interval, for a period of one year after acceptance.

D. Turn over software, and all spares at the time of, and as a condition of, acceptance.

END OF SECTION

SECTION 40 90 00
PROCESS INSTRUMENTATION, CONTROLS AND MONITORING EQUIPMENT - GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section encompasses general provisions relating to instrumentation work. Work included in this Section pertains to all instrumentation work contained in Division 26 or Division 40, unless modified therein, as though this Section was repeated in its entirety in each Section.

B. Furnish labor, materials, equipment and accessories required to provide complete operating instrumentation at the facility as described in the specifications, listed on the schedules and shown on the Drawings.

C. Install and/or connect furnished equipment, including equipment furnished by others, as detailed herein and as shown on the Drawings.

D. It is the intent of these Contract Documents that the instrumentation shall be suitable in every way for the service required. Material and all work that may be reasonably implied as being required for a complete fully functioning, automated and manually controlled facility shall be furnished at no extra cost.

E. Make field connections to process instruments and other equipment furnished under this Contract; to equipment furnished by Owner under separate contract, if any; and to reworked or relocated existing equipment as in the Contract Documents.

F. Provide mounting, mount, and wire process instruments furnished under Contract. Furnish wire, and interconnections between process instrumentation primary elements, transmitters, local indicators, and receivers. Mount and wire surge protection equipment where indicated on the Drawings.

G. Provide mounting, mount, and make field connections to "packaged" instruments furnished under this Contract. Electrically or pneumatically connect "package" control systems to other related panels or instrumentation defined by the Contract Documents.

H. Process Instrumentation equipment and materials furnished under this Contract, shall be installed under Division 40. This installation Work shall include mounting and making of process and signal connections to the equipment. This Work, with the exception of factory-mounting of certain instruments, shall be performed under the supervision of a qualified representative of the vendor of the system or equipment. This installation Work and the completed installation shall be in compliance with instructions of the above-mentioned vendor's representative and in accordance with the Drawings and documentation prepared by the vendor of the system or equipment and approved by Engineer.

1.02 RESPONSIBILITIES

A. Contractor shall assume responsibility to take field measurements of related and connecting work, and to determine the entire scope of the work required for a finished and completed project, in accordance with the Contract Documents and as approved by Engineer.

B. Drawings upon which this Contract is based show the arrangement, general design and extent of the systems and components. Systems are suitably outlined on the Drawings with regard to size, locations, general arrangements and installation details. Connections are shown in diagram form, except where in certain cases the drawings may include details giving the exact locations and arrangements. Drawings shall not be scaled to determine location. Work shall be installed in such a manner to avoid interferences.

C. Where any parts of the systems or piece of equipment are located by dimensions on the Drawings, said dimensions shall be checked and verified in the field. Should discrepancies or interferences occur which will necessitate major revisions in the work, Engineer shall be notified

immediately, and his authority secured in writing for such revisions before proceeding with the Work.

D. Drawings are intended to convey the desired method of control and operation of the instrumentation and control system. Contractor shall retain the services of the Control System Supplier to be responsible for the system analysis, design and functional adequacy of equipment necessary to achieve required systems performance and to satisfy the intent of these Contract Documents.

E. Instrumentation and controls shall be installed under the supervision of the Control System Supplier. Insofar as possible, instrumentation and control equipment shall be furnished from a single supplier. Contractor shall retain the services of the Control System Supplier to supply the complete control and instrumentation system and prepare wiring diagrams, installation drawings and changes for existing equipment.

F. Modifications or additions to the electrical conduit and wiring installation for the instrumentation and control system required by the instrumentation and control system and not shown on the Contract Drawings shall be furnished and installed by Contractor, as approved by the equipment manufacturers. Other devices or wiring including energy sources and/or converters necessary to obtain proper operation of the instrumentation and control system, shall be provided and installed by Contractor. Special interface equipment required shall be provided and installed by Contractor at no additional cost to Owner.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 77 00 - Closeout Procedures

C. Section 26 05 00 - Common Work Results for Electrical

D. Section 26 05 10 - Basic Electrical Materials and Methods

E. Section 40 91 00 - Instrumentation and Controls

1.04 REFERENCE STANDARDS

A. Equipment, materials, and systems provided shall be designed, manufactured, finished, painted, tested, inspected, packaged, shipped, stored, installed, connected, and tested in accordance with the General Industry Standards of OSHA, local, county, state, and federal laws, and in accordance with the published codes, standards, and the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing and Materials
3. AWWA - American Water Works Association
4. IEEE - Institute of Electrical and Electronics Engineers
5. ISA - Instrument Society of America
6. NEC - National Electric Code
7. NEMA - National Electrical Manufacturers Association
8. NFPA - National Fire Protection Association
9. OSHA - Occupational Safety and Health Administration (U.S. Depart. of Labor)
10. UL - Underwriter's Laboratories

1.05 REGULATORY REQUIREMENTS

A. Equipment, materials, and systems shall be UL labeled or listed except for classes of materials and equipment not available with such listing.

1.06 SUBMITTALS

A. Shop Drawings:

1. Certified drawings and diagrams for all instrumentation and control work shall be furnished by Contractor and delivered to Engineer in accordance with Section 01 33 00, Submittal Procedures. Information to be submitted for approval shall include:

    a. Schematic Wiring Diagrams

2. Contractor shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

3. Drawings shall be 24" x 36" with border, title block, symbols, etc., as used on the Contract Drawings and approved by Engineer. Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc. Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

4. Submit operating and maintenance instructions of all instrumentation and control components and equipment in accordance with Section 01 33 00.

5. Where applicable, and if Contractor desires, he may purchase mylars, vellums or electronic files (when approved by Engineer) of the process control drawings from Engineer, modify these drawings as required, and utilize them as shop drawings.

6. Bond copies will be acceptable for the approval issue only.

7. Manufacturer's specifications complete with descriptive information indicating design data underscored to assist in verification that equipment proposed is equal to or exceeds the technical requirements and intent of these specifications. Design data shall cover exact equipment furnished.

8. Dimensional outline drawings of all control and instrument enclosures including designated conduit or wireway entrances, internal equipment layouts and structural details.

9. Internal wiring diagrams of control enclosures identifying terminals and showing external and interconnecting terminals and field mounted devices.

10. Details necessary for fabrication of equipment specific to these control systems.

11. Working and/or construction drawings, showing conduit layout, locations, details, size, wire size and type and cables therein.

12. Technical information for all devices furnished.

13. Cable schedule detailing each cable, routing and all connections, as described in a format approved by Engineer.

14. A riser diagram shall be provided showing all cables, wires and conduits.

15. A complete list of all recommended spare parts and test equipment required for the upkeep of all instruments and controls devices installed under this Contract.

16. Complete parts lists of all materials and components incorporated in the system.

17. Individual manufacturer's instruction manuals for all devices.

18. Contractor shall submit as-built drawings, instruction manual material and assistance as required by Sections 01 77 00.

B. Certified Reports:

1. Contractor shall submit a certified report for control panel and associated field instruments certifying that the equipment:
    a. Has been properly installed under Control System Supplier's supervision.
    b. Is in accurate calibration.
    c. Was placed in operation in under Control System Supplier's presence.
    d. Has been checked, inspected, calibrated, and adjusted as necessary.
    e. Has been operated under maximum power variation conditions and has operated satisfactorily.
    f. Is fully covered under the terms of the guarantee.

C. Operations and Maintenance Data:

1. Submit operating and maintenance instructions of all instrumentation and control components and equipment in accordance with Section 01 33 00 and Section 01 77 00.

1.07 QUALITY ASSURANCE

A. Instruments and controls shall be installed under the supervision of Control System Supplier.

1. To ensure a coordinated instrumentation and control system, Contractor shall require the Control System Supplier to certify coordination of the overall control and instrumentation system so that all devices provided under this Contract are compatible and provide a complete and operable system.
2. Control System Supplier shall inspect each component piece of equipment supplied for each system to assure that it is new, in good working order and complies with the intent of Contract Documents.
3. Components not fulfilling these criteria shall be rejected.

1.08 INSTRUMENT IDENTIFICATION

A. Major instrumentation and equipment items or system specified shall be identified by system and tag numbers. This same number appears in the tag number designations on the drawings and on the schedule.

B. Instrumentation and equipment shall be identified by nameplates or tags.

C. Nameplates for panels and panel mounted equipment shall be as specified in the respective Section.

D. Field equipment shall be tagged with assigned instrumentation tag number and function.

1. Tags shall be white lamacoid with engraved black characters of 3/16 inch minimum height.
2. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard hose clamps and meeting the same description. In cases where this would be impractical, use 20 gage stainless steel screws installed in an unobtrusive manner.

E. In addition to tags, field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed.

1. Nameplate shall be attached by one of the above methods.

1.09 SIGNAL ISOLATORS, CONVERTERS, AND CONDITIONERS

A. Ensure that input-output signals of all instruments and control devices are compatible.

B. Unless otherwise specified, signals between field and panels shall be 4 to 20 mA DC unless specifically approved otherwise.

C. Granting such approval does not relieve the compatibility requirement above.

D. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices inside or behind control panels, or in the field at point of application.

1.10 PROCESS CONNECTIONS

A. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance.

B. Slope lines according to service to promote a self-draining or venting back to the process.

C. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shutdown of the process.

D. Include drip legs and blow-down valves for terminations of sensing lines at the instruments when mounted in such a way that condensation can accumulate.

E. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished by Contractor.

1.11 MANUFACTURER'S SERVICE

A. General:

1. Contractor shall furnish the services of a factory representative of the instrumentation equipment manufacturer to provide field supervision during installation, to direct the installation of the equipment, and to conduct initial equipment checkout and system start-up.

2. Contractor shall furnish the services of a factory trained and qualified serviceman of the manufacturers of the instrumentation equipment and accessories supplied under this Contract to perform the following:

B. Supervision:

1. Supervisory service of a trained serviceman, specifically trained on the type of equipment herein specified, shall be provided during construction to assist in, location of sleeves, methods of installing conduit and special cable, mounting piping and wiring for each type of device, and the methods of protecting all of the equipment prior to placing it in service.

C. Power Check-Out:

1. Checking the installation of all components before power is applied.

2. No form of energy shall be applied to any part of the instrumentation system prior to receipt by Engineer of a certified statement of approval of the installation from Contractor, containing his Control System Supplier’s authorization for turning on energy to the system.

D. Check-Out:

1. Placing the equipment into operation and making necessary adjustments including tests and loop checks.

2. Contractor shall provide the Control System Supplier’s services to maintain all control system equipment in good operating condition and furnish-on-call maintenance as required to minimize equipment down time, until the project has attained Substantial Completion.

a. Control System Supplier shall provide scheduled preventative maintenance based on Engineer approved listing specifying the time required for preventative maintenance on the various types of equipment and shall provide remedial maintenance services as required.

b. Additional service time shall be provided during the one-year warranty period for at least three 8-hour day service visits to the site to check and readjust the equipment supplied under this Section.

1.12 SHIPPING PRECAUTIONS

A. After completion of shop assembly and tests, all control cabinets, panels and consoles, etc., shall be enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture.

B. Dehumidifiers or desiccant materials shall be placed inside the polyethylene coverings prior to sealing. Equipment shall then be skid mounted and braced for final transport.

C. Lifting rings shall be provided for moving without removing protective coverings on all sections weighing more than 150 lbs. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling.

D. Equipment provided under this Contract shall not be delivered to the job site until scheduled for installation.

E. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.

F. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on outside of package.

G. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, shall be provided on each piece of equipment supplied under the Contract.

1.13 DELIVERY, STORAGE AND HANDLING

A. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.

B. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on outside of package.

C. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, shall be provided on each piece of equipment supplied under the Contract.

D. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and shall be adequately protected against mechanical injury or damages by water.

1.14 GUARANTEES AND WARRANTIES

A. Contractor shall guarantee work in accordance with the requirements of the Conditions of the Contract. With respect to instruments and equipment, guarantee shall cover:

1. Faulty or inadequate design
2. Improper assembly or erection
3. Defective workmanship or materials
4. Leakage, breakage, or other failure not caused by Owner misuse.

B. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty with Owner named as beneficiary.

1.15 TOOLS

A. One complete sets of any specialty instrument required to adjust and calibrate the instrumentation equipment shall be furnished with the equipment.

B. They shall include hand tools for maintenance and calibration such as: unique screwdrivers and wrenches plus other tools as required.

C. They shall be supplied in a durable case.

D. Calibration tools for instrumentation equipment such as magmeters, flowmeters, and pneumatic instruments shall also be provided.

E. A universal, portable input-output calibrator shall be provided.

F. The unit shall be suitable for use as a current or voltage source, current or voltage measuring device and as a power supply for two wire transmitters.

G. Output section shall contain 6 current and 5 voltage ranges.

H. Internal power supply shall contain 3 ranges.

I. A self-contained portable potentiometer shall also be provided.

J. Tester shall be Fluke model 789 or Engineer approved equal.

1.16 SPARE PARTS

A. Spares consumed during installation and testing shall be replaced by Contractor prior to final acceptance of the system.

B. Control System Supplier shall supply a complete list of all suggested spare parts and supplies he considers required for the continuous operation of the system.

C. List shall include catalog and serial numbers of the hardware devices, spare parts part numbers, commercial part numbers and price in effect when the list is prepared.

D. Spare parts shall be 100% of the manufacturer’s recommended spare parts for each device.

PART 2 PRODUCTS

2.01 GENERAL

A. Electronic instrumentation shall be of the solid-state type, of manufacturer's latest design; preferably designed and packaged for miniature, high density mounting configuration.

1. Where available, the instruments will be supplied with self-supporting, draw-out feature when in extended position.

2. Transmitted analog signals shall be 4-20 mAdc; however, signals between instruments within the same panel/cabinet may be 1-5V.

3. Zero base transmission signals will not be allowed, only "live zero" signals. An exception would include outputs of sensing devices specified hereafter, however, converted to compatible high-level signals for remote transmission.

B. Field mounted equipment shall be in NEMA 4X enclosures and, if required, shall include suitable strip heaters to prevent accumulation of moisture.

C. Equipment installed in hazardous areas, shall meet Class I, Group D, Division I to comply with the National Electrical Code.

D. Indicators and recorder readouts will be linear in process units.

E. Transmitters shall be provided with either integral indicators or separately mounted indicators reading in process units. Special features listed in the individual instrument specifications are required and all information listed therein shall be considered as minimum requirements.

F. Equipment furnished shall be approved for specific application by Underwriter's Laboratories, Inc., or Factory Mutual if applicable.

2.02 ELECTRICAL

A. Refer to Division 26.

B. Equipment shall be designed to operate on a 60 Hertz alternating current power source at 105 to 135 volts, except as noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

C. Switches shall have single-pole double-throw contacts rated at 600 VA.

D. Contacts for low voltage signals shall be gold flashed.

2.03 POWER FAILURE

A. Equipment shall be designed and constructed so that in the event of a power interruption the equipment shall resume normal operation without manual resetting when power is restored.

2.04 CONTROL SYSTEM SUPPLIERS

A. Available Control System Suppliers: Subject to compliance with requirements, provide a Control System Supplier of the following:

1. MAK Controls

B. Equipment specified and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to job site, and started up by a qualified and approved Control System Supplier listed under this heading. Intent is for unit responsibility.

C. Control System Supplier shall not assign any of his rights or delegate any of his obligations.

D. Direct purchase of any items by Contractor is not in compliance with this Specification and will not be permitted.

E. Control System Supplier shall assign a qualified representative to act as Project Engineer for the work efforts specified. Control System Supplier shall submit a resume outlining the qualifications of this individual to Engineer for approval within 3 days of notice to proceed. Project Engineer shall, at a minimum, have the following qualifications:

1. Successfully completed vendor factory training for the digital equipment supplied.

2. Successfully completed projects of similar size and complexity.

F. Project Engineer shall be interviewed by Engineer after the contract has been awarded. Individuals selected as Project Engineer must be approved by Engineer. Individuals not approved by Engineer shall not function as Project Engineer.

G. Project Engineer shall be the focal point for all design, fabrication, contract communications, and construction and shall be responsible for start-up and acceptance.

1. Project Engineer shall be at the factory test, at the job site during the entire construction process start-up, and at the job site during the entire acceptance procedure.

2. Only qualified and approved Control System Suppliers will be accepted as meeting this Specification.

3. Control System Supplier shall also assign a full-time service technician during the construction process effort to assist in verifying and making minor corrections to wiring which may be necessary as determined by Engineer.

4. Start-up/acceptance procedure shall not begin until all installation has been completed and any punch list items are minor in nature.

H. Installation and Start-up. Control System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time by ground from the jobsite.

2.05 TRAINING

A. General:

1. Contractor shall provide two 8-hour days of training of Owner's personnel in aspects of operation and maintenance such as direction on calibration of field instruments, fuse locations, instruction manuals, etc.

2. At-the-plant training and instructions shall be given by the Project Engineer assigned to the project by the Control System Supplier or other personnel as approved by Engineer.

B. Digital Equipment:

1. Control System Supplier shall provide comprehensive instruction for the programmable controllers and software packages supplied. This instruction shall be performed by the manufacturer of the products at their factory training facility.

2. Owner shall determine actual division of attendance. Written course materials shall be included along with hands-on exercises with instructional equipment. Factory training shall be conducted on a schedule acceptable to Owner and shall commence prior to system factory testing.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

3.02 CERTIFIED REPORTS

A. Contractor shall submit a certified report for control panel and associated field instruments certifying that the equipment:

1. Has been properly installed under Control System Supplier's supervision.

2. Is in accurate calibration.

3. Was placed in operation in under Control System Supplier's presence.

4. Has been checked, inspected, calibrated, and adjusted as necessary.

5. Has been operated under maximum power variation conditions and has operated satisfactorily.

6. Is fully covered under the terms of the guarantee.

3.03 DEMONSTRATION AND FINAL OPERATING TEST PLANS AND RESULTS

A. Submit for approval, a written plan for demonstrating that each system of equipment provided meets the specified operational requirements.

1. The plan shall include procedures to be used in final operational testing of entire system including description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary bypasses and like facilities.

3.04 PREPARATION

A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

3.05 INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with the Control System Supplier's instructions.

1. Locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by Engineer during construction.

2. Field verify information relevant to the placing of process control equipment and in case of any interference, proceed as determined by Engineer.

3. Furnish labor and materials necessary to complete the work in an approved manner.

B. Instrumentation loop diagrams on the Drawings indicate the intent of the interconnection for the instruments specified.

1. Work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, Contractor shall bear full responsibility for such violations and assume all costs arising there from.

2. Field instruments requiring power supplies shall be provided with local electrical shut-offs.

C. Brackets and hangers required for mounting of equipment shall be provided and shall be installed in a workmanlike manner so as to not interfere with other equipment.

1. Contractor shall investigate each space in the building through which equipment must pass to reach its final location.

2. If necessary, the manufacturer shall be required to ship this material in sections sized to permit passing through such restrictive areas in the building.

D. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground be employed for each shield.

1. Cable shields will be continuously maintained by termination to "shield" terminals which are not grounded except at the Main Control Panel. The sole exception is if the manufacturer requires ground of the shield at the field device.

E. Each pair of wires shall be tagged within four inches of each termination with the assigned cable, pair and terminal numbers.

1. Low energy signal (4-20 mAdc) shall be run in instrumentation cables in conduits separated from AC power, control and annunciator wiring.

2. Lifting eyes shall be removed from cabinets/assemblies.

3. Holes in cabinet or boxes shall be plugged.

4. The plug will be of the same color as the cabinet or box and shall be gasketed.

3.06 CALIBRATION AND SYSTEM VALIDATION

A. Calibration:

1. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications instructions for calibration.

2. Each instrument shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable.

3. Provide a list and basic specifications for instruments used.
4. Provide a written report to Engineer on each instrument certifying that it has been calibrated to its published specified accuracy.
    a. Report shall include applicable data as listed below plus any defects noted, correction action required, and correction made.
    b. Data shall be recorded on prepared forms and shall include not less than the following items.
        1) Facility identification (name, location).
        2) Loop identification (name or function).
        3) Equipment tag and serial numbers.
        4) Scale ranges and units.
        5) Test mode or type of test.
        6) Input values or settings.
        7) Expected outputs and tolerances.
        8) Date of actual calibration.
        9) Actual readings.
        10) Explanations or special notes as applicable.
        11) Tester's certification with name and signature.

B. System Validation:
1. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance.
    a. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output.
2. Validate each system by simulating inputs at the first element in loop (i.e., sensor) of 10%, 50%, and 90% of span, or on/off and verifying loop output devices (i.e., recorder, indicator, alarm, etc., except controllers).
    a. During system validation, make provisional settings on levels, and alarms.
    b. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
    c. Verify that alarms and logic sequences operate in accordance with the specifications.
3. Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.
4. Immediately correct defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.
5. Provide a report certifying completion of validation of each instrument system.
    a. Report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices.
    b. Data sheets shall be similar to those used for calibration.

3.07 FINAL OPERATIONAL TESTING AND ACCEPTANCE

A. Upon completion of instrument calibration and system validation, test system under process conditions.

1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.

2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.

3.08 DEMONSTRATION AND FINAL OPERATING TEST PLANS AND RESULTS

A. Submit for approval, a written plan for demonstrating that each system of equipment provided meets the specified operational requirements.

1. The plan shall include procedures to be used in final operational testing of entire system including description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary bypasses and like facilities.

B. Upon completion of instrument calibration and system validation, test system under process conditions.

1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.

2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.

C. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat and testing.

D. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total instrumentation and control system meets the functional requirements specified herein.

E. Testing shall be observed by Engineer.

1. Notify Engineer in writing a minimum of 48 hours prior to the proposed date for commencing the testing.

2. Upon completion of this test Contractor shall begin or have begun system start-up.

3. Owner reserves the right to set the schedule.

3.09 MANUFACTURER'S SERVICES

A. General:

1. Contractor shall furnish the services of a factory representative of the instrumentation equipment manufacturer to provide field supervision during installation, to direct the installation of the equipment, and to conduct initial equipment checkout and system start-up.

2. Contractor shall furnish the services of a factory trained and qualified serviceman of the manufacturers of the instrumentation equipment and accessories supplied under this Contract to perform the following:

a. Start-Up Assistance:

1) Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of 1 day at the project site to assist Engineer in field

checkout and start-up of software. This period shall be scheduled by Engineer.

2) Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of two (2) working days to assist Owner's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

b. Coordination:

1) Work shall be coordination with other trades involved in the construction project.

2) Work shall be carefully laid out in advance so that architectural, structural, mechanical, electrical, and instrumentation features of construction will be coordinated.

c. Supervision:

1) Supervisory service of a trained serviceman, specifically trained on the type of equipment herein specified, shall be provided during construction to assist in, location of sleeves, methods of installing conduit and special cable, mounting piping and wiring for each type of device, and the methods of protecting all of the equipment prior to placing it in service.

d. Power Check-Out:

1) Checking the installation of all components before power is applied.

2) No form of energy shall be applied to any part of the instrumentation system prior to receipt by Engineer of a certified statement of approval of the installation from Contractor, containing his Control System Supplier’s authorization for turning on energy to the system.

e. Check-Out:

1) Placing the equipment into operation and making necessary adjustments including tests and loop checks.

2) Contractor shall provide the Control System Supplier’s services to maintain all control system equipment in good operating condition and furnish-on-call maintenance as required to minimize equipment down time, until the project has attained Substantial Completion.

(a) Control System Supplier shall provide scheduled preventative maintenance based on Engineer approved listing specifying the time required for preventative maintenance on the various types of equipment and shall provide remedial maintenance services as required.

(b) Additional service time shall be provided during the one-year warranty period for at least three 8-hour day service visits to the site to check and readjust the equipment supplied under this Section.

3. Training:

a. Contractor shall provide two 8-hour days of training of Owner’s personnel in aspects of operation and maintenance such as direction on calibration of field instruments, fuse locations, instruction manuals, etc.

b. At-the-plant training and instructions shall be given by the Project Engineer assigned to the project by the Control System Supplier or other personnel as approved by Engineer.

c. Digital Equipment:

1) Control System Supplier shall provide comprehensive instruction for the programmable controllers and software packages supplied. This instruction shall be performed by the manufacturer of the products at their factory training facility.

2) Contractor shall submit to Engineer, an outline of the proposed training courses to meet the requirements set forth below.

   (a) Hardware training (3 individuals)

      (1) 1 day, Maintenance and Troubleshooting

   (b) Software training (3 individuals)

   (c) 1 day, Software Concepts

3) Contractor shall also provide to Engineer a list of additional courses available from the manufacturer.

4) Upon review, Engineer may request that a substitution be made of a course content that better fits the needs of Owner. Such substitution shall only be requested for courses of equal length cost and availability.

5) Owner shall determine actual division of attendance. Written course materials shall be included along with hands-on exercises with instructional equipment. Factory training shall be conducted on a schedule acceptable to Owner and shall commence prior to system factory testing.

6) For training conducted at other than Owner's facilities, Contractor shall bear all transportation (air fare, car rental, etc.) and subsistence (hotel, meals, etc.) costs for training.

   (a) Daily subsistence allowance shall be $150/day/person.

   (b) Contractor shall arrange for all training for Owner with a minimum of 6 week notification of training schedule prior to actual course being provided.

   (c) Scheduling of courses and their contents shall be approved by Engineer and provided at a time and location agreeable to Owner.

   (d) Course shall be conducted at locations normally established for such courses by manufacturers of software and computer products.

3.10 FINAL OPERATIONAL TESTING AND ACCEPTANCE

A. Upon completion of instrument calibration and system validation, test system under process conditions.

   1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.

   2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.

B. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat and testing.

C. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total instrumentation and control system meets the functional requirements specified herein.

D. Testing shall be observed by Engineer.

   1. Notify Engineer in writing a minimum of 48 hours prior to the proposed date for commencing the testing.

2. Upon completion of this test Contractor shall begin or have begun system start-up.

3. Owner reserves the right to set the schedule.

3.11 START-UP ASSISTANCE

A. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of 1 day at the project site to assist Engineer in field checkout and start-up of software. This period shall be scheduled by Engineer.

B. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of two (2) working days to assist Owner's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

3.12 COORDINATION

A. Work shall be coordination with other trades involved in the construction project.

B. Work shall be carefully laid out in advance so that architectural, structural, mechanical, electrical, and instrumentation features of construction will be coordinated.

3.13 DIGITAL EQUIPMENT

A. Digital equipment supplier shall provide an authorized, service representative for a minimum of three times at jobsite, including once during installation and start-up and once during acceptance to inspect and check out the control system.

B. Service representative shall revisit jobsite for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to Engineer.

END OF SECTION

SECTION 40 91 00
INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SCOPE OF WORK

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 05 00 - Common Work Results for Electrical

B. Section 26 05 10 - Basic Electrical Materials and Methods

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. 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

1.04 REGULATORY REQUIREMENTS

A. Equipment, materials, and systems shall be UL labeled or listed except for classes of materials and equipment not available with such listing.

1.05 SUBMITTALS

A. Operation and Maintenance Data:

1. Submit operating and maintenance instructions of all instrumentation and control components and equipment in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 40 90 00 - Process Instrumentation, Controls and Monitoring Equipment - General Requirements.

1.06 QUALITY ASSURANCE

A. Instruments and controls shall be installed under the supervision of Control System Supplier.

1. To ensure a coordinated instrumentation and control system, Contractor shall require the Control System Supplier to certify coordination of the overall control and instrumentation system so that all devices provided under this Contract are compatible and provide a complete and operable system.
2. Control System Supplier shall inspect each component piece of equipment supplied for each system to assure that it is new, in good working order and complies with the intent of Contract Documents.
3. Components not fulfilling these criteria shall be rejected.

PART 2 PRODUCTS

2.01 GENERAL

A. Electronic instrumentation shall be of the solid-state type, of manufacturer's latest design; preferably designed and packaged for miniature, high density mounting configuration.

1. Where available, the instruments will be supplied with self-supporting, draw-out feature when in extended position.

2. Transmitted analog signals shall be 4-20 mAdc; however, signals between instruments within the same panel/cabinet may be 1-5V.

3. Zero base transmission signals will not be allowed, only "live zero" signals. An exception would include outputs of sensing devices specified hereafter, however, converted to compatible high-level signals for remote transmission.

B. Field mounted equipment shall be in NEMA 4X enclosures and, if required, shall include suitable strip heaters to prevent accumulation of moisture.

C. Equipment installed in hazardous areas, shall meet Class I, Group D, Division I to comply with the National Electrical Code.

D. Indicators and recorder readouts will be linear in process units.

E. Transmitters shall be provided with either integral indicators or separately mounted indicators reading in process units. Special features listed in the individual instrument specifications are required and all information listed therein shall be considered as minimum requirements.

F. Equipment furnished shall be approved for specific application by Underwriter's Laboratories, Inc., or Factory Mutual if applicable.

2.02 ELECTRICAL

A. Refer to Division 26.

B. Equipment shall be designed to operate on a 60 Hertz alternating current power source at 105 to 135 volts, except as noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

C. Switches shall have single-pole double-throw contacts rated at 600 VA.

D. Contacts for low voltage signals shall be gold flashed.

2.03 POWER FAILURE

A. Equipment shall be designed and constructed so that in the event of a power interruption the equipment shall resume normal operation without manual resetting when power is restored.

2.04 CONTROL SYSTEM SUPPLIERS

A. Available Control System Suppliers: Subject to compliance with requirements, provide a Control System Supplier of the following:

1. MAK Controls

B. Equipment specified and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to job site, and started up by a qualified and approved Control System Supplier listed under this heading. Intent is for unit responsibility.

C. Control System Supplier shall not assign any of his rights or delegate any of his obligations.

D. Direct purchase of any items by Contractor is not in compliance with this Specification and will not be permitted.

E. Control System Supplier shall assign a qualified representative to act as Project Engineer for the work efforts specified. Control System Supplier shall submit a resume outlining the qualifications of this individual to Engineer for approval within 3 days of notice to proceed. Project Engineer shall, at a minimum, have the following qualifications:

1. Successfully completed vendor factory training for the digital equipment supplied.
2. Successfully completed projects of similar size and complexity.

F. Project Engineer shall be interviewed by Engineer after the contract has been awarded. Individuals selected as Project Engineer must be approved by Engineer. Individuals not approved by Engineer shall not function as Project Engineer.

G. Project Engineer shall be the focal point for all design, fabrication, contract communications, and construction and shall be responsible for start-up and acceptance.

1. Project Engineer shall be at the factory test, at the job site during the entire construction process start-up, and at the job site during the entire acceptance procedure.
2. Only qualified and approved Control System Suppliers will be accepted as meeting this Specification.
3. Control System Supplier shall also assign a full-time service technician during the construction process effort to assist in verifying and making minor corrections to wiring which may be necessary as determined by Engineer.
4. Start-up/acceptance procedure shall not begin until all installation has been completed and any punch list items are minor in nature.

H. Installation and Start-up. Control System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time by ground from the jobsite.

PART 2 PRODUCTS

3.01 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&ID in Contract Drawings.

C. Float Switches:

1. Function: Provide discrete level measurement.
2. Operation: Changes in level causing tilt in float activating switch.
3. Float Material: Polypropylene, or material compatible with the fluid that is contact with the float.
4. Cable: Length as required; Type SO Nitril PVC jacketed with 3 No. 14 AWG stranded conductors.
5. Switch Rating: Mechanical switch (no mercury), 10 amps at 115 VAC.

D. Proximity Switches:

1. Function: Provide indication of presence or movement of mechanical components
2. Operation: Changes in level causing tilt in float activating switch.
3. Enclosure: Stainless steel, side sensing, intrinsically safe

4. Cable: Length as required; Type SO Nitril PVC jacketed with 3 No. 14 AWG stranded conductors.
5. Switch Rating: SPDT switch, 10 amps at 115 VAC, 3 amps at 24 VDC.
6. Manufacturer: Subsea Model 11 GO Switch by Emerson Process Management

E. Intrinsically Safe Relay:
1. Function: Interface control in explosive atmospheres
2. Type: Solid state electronic
3. Input Signal Value: Less than 1 ma @ 9.6 VDC
4. Output Signal Value: Contact closure - 10 amp resistive rated 2 N.O. + 2 N.C. independent and isolated
5. Power Supply: 120 V - 1 PH - 60 HZ
6. Power Consumption: 6 watts or 9 V.A.
7. Power Terminals: Plug-in quick connect tabs
8. Approval: FM (Factory Mutual)
9. Sensitivity Adjust: 10,000 ohm to 1 megohm
10. Manufacturer: Turck IM1-22EX-R, or equal

F. Electronic Dual Current Switch:
1. Function: Monitor input signal and trip at set point
2. Type: Direct current switch suitable for panel mounting
3. Input: 4 to 20 MA
4. Output: DPDT relay contacts rated 5 A at 117 VAC noninductive
5. Power: 117 VAC 50/60 HZ at 10%
6. Manufacturer: Adtech or equal

G. Pilot Indicating Light:
1. Function: Visual indication of control function
2. Type: Heavy-duty; oil-tight or weatherproof as required; transformer type; push-to-test LED
3. Input: 120 volts, 60 HZ
4. Color Cap: Plastic
5. Color Designation:
    a. Red - “Stop” or “Alarm”
    b. Green - “Start” or “Running”
    c. Blue - “Overload”
    d. White - “Power On” or “Opened”
    e. Amber - “Closed”
    f. Clear - "Defined Status" "Ground"
6. Mounting: Mounting hole 1 13/64" D; Pilot hole 1/4" D; Space between holes 9/16" minimum

H. Pushbutton:

1. Function: Manual operator control
2. Type: Oil-tight or weatherproof, momentary or maintained contact as required; emergency stop shall be maintained, push to open, pull to close
3. Contacts: 1 N.O. and I.N.C. (minimum) Provide contact arrangements as required to perform desired control
4. Rating: 10 amp @ 120 VAC continuous
5. Mounting: Mounting hole 1 13/64" D
6. Operator: Extended head
    a. Start, open, close or run function - black operator
    b. Stop function - red operator
    c. Silence - black operator

I. Selector Switch:

1. Function: Manual control mode selection
2. Type: Heavy-duty, Oil-tight or weatherproof, as required
3. Application: See Contract Drawings
4. Positions: Two-three-four (as required)
5. Contacts: Form a or Form b (as required) (Form c not acceptable)
6. Operator: Knob level type
7. Contact Rating: 120 VAC - 10 amp continuous (60 amp make - 6 amp break)
8. Mounting: Mounting hole 1 13/16" D
9. Options:
    a. Spring return as required
    b. Cylinder key lock as required

J. Gage Pressure Transducer/Transmitter:

1. Function: Provide analog pressure measurement
2. Type: Pressure transducer with 4-20 mA output proportional to system pressure
3. Housing: NEMA 4
4. Fill Fluid: Silicone Oil
5. Wetted Parts: 316L Stainless Steel
6. Output: 4-20 mA analog signal
7. Manufacturer: Siemens Sitrans P

K. Redundant Power Supply:

1. Function: Provide 24 volt power
2. Type: Switching redundant power supply with controller
3. Input: 115 VAC
4. Output: 24 VDC
5. Housing: NEMA 12

6. Ripple: No more than 50 mV peak to peak
7. Manufacturer: Puls QS10.241 supply, with YRM2.DIODE or SOLA SDN-24-100P supply with SDN 2.5-20RED

L. Temperature Transducer/Transmitter:
1. Function: Provide analog temperature measurement
2. Type: Transmitter/transducer with 4-20 mA output proportional to ambient temperature
3. Housing: NEMA 7
4. Range: 0 - 100 degrees Fahrenheit
5. Wetted Parts: 316L Stainless Steel
6. Output: 4-20 mA analog signal
7. Certification: Factory Mutual (Class I, Division I)
8. Manufacturer: Dwyer Instruments model TTE-106-W-LCD with A-287 pipe mounting bracket, or Engineer approved equal.

M. Pressure Switch:
1. Function: Provide discrete indication of pressure
2. Type: Machine Tool, NEMA 4, diaphragm actuated
3. Range:
   a. 3-150 psi nominal on decreasing pressure
   b. 6-30 psi nominal adjustable differential
4. 475 psig nominal maximum pressure
5. Contacts: DPDT
6. Manufacturer: Square-D or Allen-Bradley

N. Intrinsic Safety Barrier:
1. Function: Interface control in explosive atmospheres
2. Type: Solid state electronic
3. Input Signal Value: Less than 1 VDC to field device
4. Output Signal Value: 4-20 mADC to control system
5. Approval: FM
6. Manufacturer: Turck IM33-11Ex-HI/24VDC or approved equal

O. Submersible Pressure Transducer/Transmitter:
1. Function: Provide analog pressure measurement
2. Type: Pressure transducer with 4-20 mA output proportional to system pressure
3. Wetted Parts:316 Stainless steel
4. Output: 4-20 mA
5. Accuracy: 0.25%
6. Manufacturer: KPSI/Esterline

P. Panel Meters (Indicators):
1. Function: Provide visual indication of process variables

2. Type: 4-digit LCD with field selectable decimal point
3. Adjustments: Field adjustable zero and span
4. Housing: NEMA 4X
5. Input: 4 to 20 maDC
6. Power: 24 VDC loop powered
7. Manufacturer: Precision Digital or approved equal

Q. Signal Splitter:
1. Adjustments: Field adjustable zero and span
2. Housing: NEMA 1
3. Input: 4 to 20 maDC
4. Output: 4 to 20 maDC
5. Power: 24 VDC
6. Manufacturer: Acromag, Adtech, or approved equal

R. Ice Cube Relays (for use within PLC Panel and Valve Control Panel only):
1. Function: Relay logic
2. Type: Heavy-duty plug in, with internal pilot light
3. Contact Arrangement: 4PDT minimum, 10 amp rating
4. Construction: Clear polycarbonate cover with epoxy encapsulated coil
5. Mounting: Pin terminal-type socket
6. Options: Pilot light, Time delay function (where applicable)
7. Manufacturer: IDEC, Square-D, Allen-Bradley, General Electric, Cutler-Hammer, or approved equal

S. Machine Tool Relays (for all use except within the PLC Panel and Valve Control Panel):
1. Function: Relay logic
2. Type: Heavy-duty Machine Tool
3. Contact Arrangement: 4PDT minimum, 10 amp rating, field convertible contacts
4. Mounting: Relay mounting track, direct subpanel mount
5. Options: Time delay function (where applicable)
6. Manufacturer: IDEC, Square-D, Allen-Bradley, General Electric, Cutler-Hammer, or approved equal

T. Circuit Breakers:
1. Function: Provide overcurrent protection
2. Type: Molded-case. Provide voltage and amperage ratings as required
3. Manufacturer: Square-D, or approved equal

U. Uninterruptible Power Supply and Manual Bypass Switch:
1. Function: Provide back-up 120 VAC power.
2. Type: On-line, double-conversion with fault tolerant auto-bypass
3. Input: 120 VAC

4. Output: 120 VAC (minimum of six 5-15/20R receptacles)
5. VA Output: As required to meet full load plus 20% spare capacity
6. Runtime: Provide batteries as necessary for 1 hour of run-time at full load
7. Communication:DB9 serial port (RS232 and contact closure supported)
8. Bypass Switch: Manual bypass switch shall be make-before-break type.
9. Manufacturer: Powerware (Eaton) Ferrups, Tripp-Lite (SmartOnline “SU” series) or approved equal

V. Ethernet Switch:
1. Function: Provide connectivity between Ethernet devices
2. Type: Unmanaged, 5 RJ45 ports, 10/100 MBit/s
3. Power: 24 VDC
4. Manufacturer: Sixnet, Phoenix Contact, Hirschmann, or approved equal

W. Control Panel Power Surge Suppressor:
1. Function: Provide surge protection
2. Type: 120 VAC, 1-phase, 3-wire, 10 kA
3. Manufacturer: Emerson IE-120, EDCO model HSP121BT-1RU, Square-D model SDSA1175, or approved equal

X. Digital Signal Surge Suppressor (for use on digital PLC inputs):
1. Function: Provide surge protection
2. Type: 150 VAC, 1250 amp surge current MOV
3. Manufacturer: Phoenix Contact TT-2/2-M-24VDC or approved equal

Y. Analog Signal Surge Suppressor (for use on analog transmitters and analog PLC inputs):
1. Function: Dissipate electrical surge
2. Type: Socket-mount
3. Surge Rating: 10kA (8 x 20 microseconds), SAD hybrid technology
4. Manufacturer: Phoenix Contact TT-2-PE-M-24VDC or approved equal

Z. Ultrasonic Level Transmitter:
1. Service (s): Chemical storage tank storage level
2. Measuring Range: 0 ft to 15 ft of liquid
3. Accuracy: ± 0.2% full scale
4. Repeatability: ± 0.1% full scale per year
5. Response Time: 150 ms
6. Pressure Range: N/A
7. Temperature Range: Operating: 14° to 158°F (-10°C to 70°C)
8. Storage: -40° to 176°F (-40°C to 80°C)
9. Transmitter Type: Ultrasonic
10. Output Signal: 4-20 mA
11. Enclosure Rating: NEMA 4X (IP68)

12. Process Connections: Process flange on tank
13. Power Supply: 120 VAC
14. Materials: Sensor Housing: Kynar
15. Acceptable Manufacturer: HydroRanger 200, manufactured by Siemens

AA. Combustible Gas Element and Transmitter:

1. General:
    a. Function: Continuously monitor ambient air for lower explosive limit (LEL) of combustible hydrocarbon based gases.
    b. Sensor Type: Poison-resistant infrared type.
    c. Parts: Element/transmitter, calibration kit, and ancillaries.
2. Performance:
    a. Range: 0 to 100 percent LEL.
    b. Repeatability: +/- 1 percent of full scale.
    c. Analog output accuracy: +/- 1 percent of full scale.
    d. Long Term Drift (6 Months): Less than +/- 1 percent LEL.
    e. Response Time: Less than 15 seconds.
    f. Temperature (Operating): Element/Transmitter: - 40 degrees F to +200 degrees F.
    g. Humidity, Operating (Both Element/Transmitter): 0 percent to 95 percent relative humidity, noncondensing.
3. Element Sensor:
    a. Number of Sensors: One.
    b. Gas Monitored: Combustible gas.
    c. Combustible Gas Sensor Type: Poison-resistant infrared type.
    d. Enclosure: Suitable for NEC, Class 1, Division 1, Groups C and D hazardous areas.
    e. Mount as follows: Wall mount.
4. Transmitter:
    a. Integral with element/sensor.
    b. LCD Display.
    c. Non-intrusive interface for functional, calibration, and alarm testing.
    d. Enclosure: Explosion proof, suitable for Class 1, Division 1, Group C and Group D. Minimum of four-wire entry holes.
    e. Mounting: Wall.
    f. Signal Interface: 4 to 20 mA dc.
    g. Power: 24 VDC, obtained from PLC Panel.
5. Calibration System:
    a. Zero and Span Adjustment: One remote control calibrator unit for calibration of all combustible gas sensors, without declassifying the area, and without opening the sensor enclosure.

b. Calibration Check Kit: With all accessories, including cylinder of the gas being monitored.

6. Manufacturer and Product:

   a. MSA Ultima X element/sensor

7. PLC Panel:

   a. Panel shall be stainless steel or aluminum NEMA 4, totally enclosed one-piece design, pad-mounted and free-standing. Material shall be not less than 12 gage, reinforced and plug welded to angle frames. Construction incorporating a frame with light gage skin will not be acceptable. Panel shall have front access and be constructed by a UL listed panel manufacturer in strict compliance with NEMA and UL Standards.

   b. The panel shall be factory assembled, wired, and tested. All wiring shall be neatly installed in horizontal and vertical runs. Terminals shall be so arranged to provide complete accessibility to all items.

   c. Panel face openings for mounting equipment shall be smoothly finished cut with counter boring and trim strips provided as required to give a neat, finished appearance.

   d. Enclosure doors shall be hinged with removable hinge pins. Each door shall incorporate a vault type handle with three-point latching mechanism for securing door in closed position, door locks shall be keyed alike. Only smooth rubber gasket material shall be used for providing door seal.

   e. Joined edges, corners, and seams shall be of continuous bead weld (no filler or dubbing) and ground to a finish so as not to be detectable after painting. Spot welds shall be used only to connect flat metal surfaces to structural support bracing to provide rigidity. Care shall be taken to prevent warping of metal.

   f. Inside surfaces shall be painted with a high-gloss white and the outside surface shall be painted with a color selected by the Owner.

   g. Removable "eye" bolts shall be provided to facilitate slinging and handling of enclosures. "Eye" bolts shall be mounted directly to and be part of the enclosure structural members so as to distribute the stresses and enclosure weight while slinging.

   h. Each floor standing-type panel shall be equipped with interior panel service lighting system and quadplex receptacle as a minimum.

   i. Panel layout and equipment spacing shall be sufficient to allow for device removal and maintenance without disassembly of adjacent devices. Additionally, ample panel gutter space (sides, top, and bottom) shall be provided for training wires and cables.

   j. Plastic wireway shall be used to route wires in all control panels and enclosures. Wireway fill shall not exceed 60 percent and shall be run in continuous lengths with snap-on type covers.

   k. Each and every wire both internal and external to the panel shall be tagged at both ends with its respective wire number. Internal panel wiring will be No. 14 AWG, MTW 600 volts working, 1,500 volts test, Class C stranding with 2/64-inch minimum, 90° C insulation. All panel wiring not run in wire ducts shall be bundled and tied. Wire markers shall be provided at each wire termination point. All wires to internal components shall be connected to the "outside" of the terminal strip. No more than two wires shall be connected to any one terminal point.

   l. Power wiring shall be black for hot and white for neutral. Control wiring shall be red for AC and blue for DC. Yellow wire shall be used on circuits which receive from two

sources not controlled by the panel disconnect. Green wire shall be used for ground. Shielded cable shall be black and white No. 16 AWG with aluminum mylar with bleed ground wire and provided with an overall PVC jacket.

m. PLC digital input and output signals shall be fused protected using fused terminal blocks. PLC inputs shall be surge protected using the surge suppressors listed in the specification.

n. The radio shall be mounted in the PLC panel.

PART 3 EXECUTION

4.01 INSTALLATION

A. Installation of all equipment, materials, and components shall be by Contractor under the direct supervision of the manufacturer and as indicated on the Contract Drawings.

4.02 FIELD QUALITY CONTROL

A. Testing on equipment, materials, and components herein specified shall be as specified in Section 40 90 00 - Process Instrumentation, Controls and Monitoring Equipment - General Requirements, Section 26 05 00 - Common Work Results for Electrical and Section 26 05 10 - Basic Electrical Materials and Methods.

4.03 ADJUSTMENTS

A. Contractor shall make all adjustments necessary to place 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 Contract Documents and manufacturer's recommendations, make 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.

4.04 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 to 10 V (source) 0 to 30 V (measure)	0.01 mV 0.001 V 0.001 V	0.02% Rdg. +2 LSD
mA	0 to 24	0.001 mA	0.02% Rdg. +2 LSD
mV	-10.00 mV to +75.00mV	0.025% of range +1 LSD	
Resistance	0 Ω to 3200 Ω (measure)	0.01 Ω to 1.0 Ω	

	15 Ω to 3200 Ω (source)		
Frequency (source)	2.0 to 1000.0 CPM 1 to 1000 Hz 1.0 to 10.0 kHz	0.1 CPM 1Hz 0.1 kHz	±.05% of setting ±.05% of setting ±.25% of setting
Frequency (measure)	1 CPM to 10 kHz	5 digits	0.05% Rdg +1 count
Loop Supply	24 V dc		10%

4.05 SPARE PARTS AND CONSUMABLES

A. To minimize "down time," the following spare parts and consumables shall be turned over to Owner at time of start-up:

1. Spare Parts:

a. Contractor shall furnish as manufacturer's spare parts, 10 percent of the total used of each type of pilot light lamp, relay, push button of each type and head color furnished, and selector switches of each type furnished.

END OF SECTION

SECTION 46 21 83
SEPTAGE RECEIVING EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section includes fully automatic, self-cleaning, dual drive septage receiving units and their associated motor controllers. Equipment shall be installed as shown on the plans, as specified herein, as recommended by the supplier and in compliance with all local, state and federal codes and regulations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 60 00 - Product Requirements

C. Section 01 77 00 - Closeout Procedures

1.03 DESCRIPTION OF SYSTEM

A. The proposed septage receiving equipment has been designed based on the Beast Septage receiving unit by SAVÉCO North America, Inc.

1.04 REFERENCE STANDARDS

A. Unless otherwise specified, the work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ABMA - American Bearing Manufacturers Association
3. ASME - American Society of Mechanical Engineers
4. ASTM - American Society for Testing and Materials
5. AWS - American Welding Society Code
6. NEC - National Electrical Code
7. NEMA - National Electrical Manufacturers' Association
8. NFPA - National Fire Protection Association
9. UL – Underwriters Laboratory Standards

1.05 QUALITY ASSURANCE

A. Source Quality Control:

1. One manufacturer will be responsible for the supply of the proprietary dual drive Beast Septage receiving system as specified herein. The equipment manufacturer will have no less than five (5) years' experience in the design and manufacturing of the Beast Septage receiving system with at least twenty (20) installations. No deviations from this specification and system design shall be accepted.
2. Any manufacturer, other than named, must successfully pilot at the installation site.

B. Each septage receiving unit will be fully assembled and shop tested to confirm fit and function of the unit. A certificate of the shop test shall be supplied with the shipping documents.

C. Each septage receiving unit will be shipped to the site fully assembled, some ancillary components may be removed to prevent damage during shipment.

1.06 SUBMITTALS

A. Furnish the required number of submittals to verify compliance with the specification. Submittals shall include:

1. Technical Information:

a. Pertinent information needed to fully describe the equipment and accessories shall be included in the submittal. Where multiple options are included within standard literature, project specific part numbers and options shall be highlighted by enclosing the project-specific information (circling, clouding, text boxes) and other information shall be crossed out. Any deviations to these specifications must be listed on a separate page referencing the specification section with a brief description of the deviation and why it is equal to or superior to what is specified. Submittals for each size and type shall include, but not be limited to the following:

1) Name of Manufacturer

2) Type and Model

3) Motor performance data and features

4) Major component materials of construction

5) Gear reducer data including service, efficiency, torque rating and materials of construction

2. Operation & Maintenance (O&M) Manuals

a. Equipment Operating instructions

b. Equipment weights and lifting instructions

c. Installation instructions

d. Maintenance schedules

e. Recommended lubricants

f. Recommended spare parts including wear items

g. Long-term and short-term storage instructions

3. Equipment Information:

a. Warranty for the proposed equipment.

b. Brochures and other descriptive literature

c. Installation reference list

d. Manufacturer’s recommended spare parts.

B. Certification:

1. The manufacturer shall provide an affidavit of compliance with all applicable provisions of this specification.

C. Shop Performance Testing:

1. As specified herein.

D. Testing and Inspection Report:

1. Prior to start-up the manufacture shall certify, in writing, that the completed installation is in accordance with his recommendations.

E. Operation and Maintenance Data:

1. Submit operating instructions, repair parts listing and recommended maintenance schedule of inspection, cleaning and lubrication. Include manufacturer's recommended lubricants.

F. Warranty:

1. Submit in accordance with the requirements of Section 01 77 00 - Closeout Procedures, covering the items included under this Section.

2. Equipment will be covered against manufacturing defects in materials and workmanship during normal use and service for a period of one (1) year from date of start up as long as periodic maintenance procedures are followed and performed. Items specifically not covered by the one-year warranty are consumable wear parts as identified in the O&M manual(s).

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Storage of Materials and Equipment:

1. Contractor shall store material and each piece of equipment in accordance with the manufacturer's recommendation for protection from weather, temperature, and moisture contamination.

B. Handling Materials and Equipment:

1. Material shall be handled in a manner such as to eliminate the possibility of damage, breakage, or chipping in transit or otherwise.

1.08 PERFORMANCE REQUIREMENTS

A. The following requirements will be met for each unit to be furnished and installed:

Condition	Unit
Influent Type	Commercial hauled waste
Influent Solids Concentration (mg/l)	1 to 4%
Peak flow per screen (gpm)	660
Perforation Size (mm)	6
Drum Basket Nominal Diameter (inches)	47
Inlet Connection (inches)	4 (flanged)
Outlet Connection (inches)	10 (flanged)
Discharge Height from Operating Level (feet)	5.6
Drum Installation Angle (degrees)	25
Drum Motor HP	2.0
Screw Motor HP	2.0
High Pressure Spray Wash Water (gpm/psi)	48 @ 40 to 60
Power Supply (V/P/Hz)	480 / 3 / 60
Installation Location (indoor/outdoor)	Indoor
NFPA Classification Requirement	Class 1, Div 1
Control Panel Location (indoor/outdoor)	Indoor
Control Panel NFPA Classification Requirement	Non-hazardous

PART 2 PRODUCTS

2.01 GENERAL

A. Equipment provided shall be a fully automatic, self-cleaning, Beast Septage receiving unit incorporating a perforated plate rotating drum screen and an integral screenings washing, conveying and dewatering/compacting system contained within a stainless steel tank. The tank

mounted rotating drum screen unit will be provided with an angle-of-inclination of 25˚ from horizontal.

B. Each rotating drum screen unit shall be provided with a rotating screen basket, exterior basket cleaning spray bar(s), exterior basket cleaning brush, concentric transport screw with integral screenings washing, dewatering and screenings compaction zone.

C. Fabricate all parts and assemblies from type 304 stainless steel unless otherwise noted.

2.02 ROTATING DRUM SCREEN BASKET

A. The drum screen basket shall be designed and built to withstand the maximum possible static hydraulic forces exerted on the screen by the liquid flow. Structural and functional parts shall be sized to prevent deflections or vibrations that may impair the screening, conveying, washing and compacting operations.

B. The drum screen basket shall be mounted at the drive end using a large diameter, single row, heavy duty industrial bearing assembly with integral ring gear comprising part of the drive system. The bearing assembly shall have a built-in grease fitting.

C. The drum screen basket shall be of a cylindrical shape with perforations around the entire basket.

D. The drum screen basket shall be perforated plate with maximum openings of 6 mm. Bar screens, wire mesh or wedge wire, or stationary screens of any type will not be acceptable screen media.

E. The drum screen basket shall have angled lifting vanes to retain loose solids during rotation and lift them up and into the screw auger trough. Helical shaped vanes which can tumble screenings rather than lift screenings shall not be accepted.

F. The screenings collection trough shall extend beyond the screen opening at the influent end to maximize solids capture and reduce screenings recycle.

G. The drum screen shall have no support arms on the influent side of the screen basket to snag and accumulate long stringy solids. Screens with influent side support arms will not be accepted.

H. The drum screen basket shall be provided with a seal system incorporating an HDPE seal. Any unit which does not incorporate this design will not be accepted.

2.03 DRUM SCREEN BASKET CLEANING BRUSH AND SPRAY BAR(S)

A. The exterior of the rotating drum screen basket assembly shall be cleaned by a high-pressure stainless steel spray bar and a stainless steel backed polypropylene brush. The drum screen basket shall continuously rotate in one direction during the cleaning cycle and pass through the topmost portion where it is cleaned by the spray bar and brush.

B. The exterior cleaning brush shall be mounted on a holding device which keeps the brush in constant contact with the screen basket and can be adjusted to compensate for brush wear.

2.04 SCREENINGS TRANSPORT SCREW AND DEWATERING ZONE

A. The screenings transport screw shall be constructed of an epoxy coated high strength alloy steel for maximum torsion resistance in the screw. The screw shall be near-white blasted, primed with an inorganic zinc primer and coated with a 2-part epoxy.

B. The screenings collection trough shall be attached to the screenings transport tube by a drum support flange. The screw drive assembly shall be attached via a drive support flange welded to the upper end of the screenings transport tube.

C. The concentric transport/dewatering screw shall be designed to transport and dewater the screened material. The unit shall be provided with screw flights of constant pitch approaching

the compaction zone to prevent clogging in the compaction zone. Designs incorporating a decreasing pitch screw will not be accepted.

D. The screenings transport screw shall be supported by a sealed, self-lubricating lower bronze bushing. The lower bushing shall be designed such that it does not take any thrust load from the transport screw. Designs requiring bearings of any type or externally lubricated bushing(s) or water injection into the housing shall not be accepted.

E. The compaction zone shall be integral to the transport screw and compaction tube. The compaction zone shall be designed to form a screenings plug and return water released from the screened material back to the tank through circular holes that are machined into the screenings compaction tube.

F. The compaction zone housing shall be fabricated entirely of stainless steel. The lower body shall be a welded construction with a minimum of 10 mm end plates for maximum torsion resistance. The bottom of the compaction zone shall be curved to promote maximum cleaning and minimum depositing of materials. Units utilizing a fiberglass reinforced compaction zone housing will not be accepted.

G. The compaction zone shall be furnished with a latched, hinged access cover with a gasket. The access cover shall incorporate a motor cut-out switch to prevent operation of the unit with the access cover open. Units which require the use of any tools to gain access to the compaction zone will not be accepted.

2.05 SPRAY WASH SYSTEMS

A. Drum and flush spray systems shall each be furnished with an automatically controlled electrically actuated full port stainless steel ball valve, stainless steel piping and fittings, flexible reinforced hoses and spray nozzles.

B. Compaction zone spray system shall be furnished with a control solenoid valve, stainless steel piping and fittings, flexible reinforced hoses and spray system.

C. A drum wash system shall be located over the rotating perforated drum which utilizes a spray bar(s) with adequate spray nozzles to ensure a consistent spray pattern over the entire length of the drum.

D. A screenings spray wash system shall be located in the lower section of the transport tube to break up and return organic materials to the flow stream and to ensure maximum screenings washing.

E. A compaction zone wash system shall be provided which periodically cleans the compaction and dewatering zone via a stainless steel wash system located in the uppermost end of the compaction/dewatering chamber. The header shall be designed to completely wash the full surface of the transport tube drainage area.

2.06 SCREEN TANK

A. Septage receiving unit shall be supplied with a two-stage stainless steel tank. The bottom of the influent section of the tank shall be sloped toward the screen to eliminate sedimentation. The inlet section shall be sized to match the inlet shape of the drum to prevent a wall for solids to dam and collect. Units with rectangular tanks which encourage sedimentation shall not be accepted.

B. The second stage tank shall house the rotating drum screen unit.

C. The inlet stage of the tank shall be provided with a flush wash system.

2.07 DRIVE UNITS

A. Septage receiving unit shall be a dual drive system which allows the drum and screw to be driven independently to optimize solids removal.

B. Gear reducers shall be a helical gear type as manufactured by NORD or approved equal. Provide a cast iron frame; design in accordance with AGMA recommendations for wastewater service.

C. Transport screw shall be directly driven by a flange mounted gear reducer.

D. The transport screw gear reducer shall be bolted to a machined flange welded to the upper end of the transport tube.

E. The rotating screen drum basket shall be driven by a flange mounted gear reducer using a spur gear and bull gear assembly.

F. Gear reducers shall be driven by 240/480V, 3 ph, 60 hz motors rated for the installation environment location. Motor horsepower shall be as noted herein.

G. Chain drives, belt drives, friction drives, or hydraulic drives will not be accepted.

H. Designs incorporating a separate upper bearing for the transport screw will not be accepted.

2.08 DRUM RETRACTION

A. The complete screen assembly must be able to be retracted away from the front seal plate to allow for replacement of the seal without pivoting the screen or requiring lifting devices such as cranes or come along hoists.

B. Units that require pivoting of the screen for seal replacement shall be required to provide a complete workable lifting system.

2.09 PIVOT ASSEMBLY

A. The complete screen assembly must be able to pivot out of the tank without requiring the removal of the drive unit, screw or drum. Units that require disassembly of the unit shall not be allowed.

2.10 ELECTRICAL CONTROLS AND DEVICES

A. Each unit will be equipped with a 480 volt primary control panel shall be provided with a type 304, stainless steel, NEMA 4X enclosure. Panel shall be suitable for wall mounting with the following electrical components to provide proper operation of the equipment:

1. Step down control transformer
2. Branch circuit protection
3. Motor starter, soft start w/ overload (drum motor)
4. Motor starter, reversing w/ overload (screw motor)
5. Emergency stop pushbutton
6. Hand-Off-Auto selector switches for drum and screw drive
7. Open-Close-Auto switches for screen drum and tank flush wash water electrically actuated ball valves
8. Open-Close-Auto switch for compaction zone wash water solenoid valve
9. Load monitors shall provide overload protection for drum and screw by sensing motor power factor
10. Hour meter for each motor
11. Control power on, run and fault indicating lights
12. Alarm reset pushbutton
13. Allen-Bradley Micro850 with Ethernet and required IO
14. Operator Interface Unit, Allen Bradley PanelView 800 with 4 inch screen

15. Ethernet Switch, 5 Port, (unmanaged).
16. Run and alarm auxiliary contacts for use by the customer
17. Intrinsically safe relay for level sensor
18. Panel Heater, with Thermostat
19. UL508A

B. Motor Cut-out Switch: One (1) interlock switch suitable for the area classification shall be factory mounted to the compaction/discharge zone access door. Interlock switch shall prevent operation of the screen while the door is open.

C. Electrically Actuated Ball Valves: Provide two (2) electrically actuated full port 316 stainless steel ball valve to control flow to the drum spray wash and tank flush assemblies. The full port ball valve shall be 2-piece body, threaded ends, cast body from CF8M, 316 stainless steel, ball and stem from 316 stainless steel, and RTFE seats. Each valve shall be controlled by a NEMA 7 electric actuator with a housing from cast aluminum with thermally bonded polyester power coating, stainless steel output shaft, stainless steel fasteners, 120 volt, single phase, 60 Hz, two SPDT limit switches, and visual indication on valve position.

D. Solenoid Valve: Provide one (1) NEMA 7 solenoid valve to control flow to the compaction zone spray wash assembly. Valve shall have a brass body. Valve shall be 120 volt, single phase, 60 Hz.

E. Level Control: Provide one (1) non-contacting radar transmitter for operation of the unit by screen start level and high level. Unit shall not be affected by FOG, debris or foam. The radar unit shall provide a 4-20mA level signal and be rated for installation in a Class 1, Div. 1/Div. 2 area when using an intrinsically safe circuit. The sensor shall be supplied with 33 feet of integral cable.

F. One (1) 4-inch inlet pinch-type valve for controlling flow into the unit. Pinch valve to be Red Valve Type A, full port design with cast iron body, ANSI Class 125/150 flanges and Buna-N elastomers. One (1) 1/2-inch 3-way brass body solenoid valve to control pinch valve operation, suitable for 120 VAC operation with electrical rating as noted herein.

G. One (1) ABB 4-inch Flow meter, Hard Rubber liner, Hastelloy C-4 measuring electrodes, carbon steel Class 150 ANSI flanges, stainless steel grounding rings, 1/2-inch NPT conduit entry, HART, 20mA, or Pulse output signal types, suitable for a Class 1, Division 1 hazardous environment with integral mount transmitter.

2.11 HAULER ACCESS STATION

A. Panel shall include the following components:

1. Power Required: 120VAC, 5A
2. Enclosure, NEMA 4X 304 Stainless Steel, 24” x 24”, with interior door and sub-panel
3. Heavy Duty Key Lockable enclosure handle, with 3 Point door mechanism
4. Panel Heater Kit, Heavy Duty with Thermostat
5. Keypad, Stainless Steel, USB Type.
6. Magnetic card swipe with 100 magnetic cards (optional).
7. User Display, Stainless Steel Bezel, Full Color, 1000 NIT Brightness.
8. Thermal Printer, Large Capacity paper roll and feeder, with illuminated print done chute.
9. Power Supply, 24 VDC.
10. Communication Controller, Solid State Storage, Dual LAN.
11. Local I/O Control as required.

12. UL Label, Industrial Control Assembly.

B. Provide a secured Hauler Access Station with each septage receiving unit that shall identify waste haulers and be configurable to interface with associated equipment such as doors, gates, valves, samplers, and screens and washers.

C. Hauler access shall be established using a keypad.

D. Hauler Access Station shall be constructed with an outer door that can be closed to enable a wash down of the area without damaging the internal mounted devices.

E. Hauler will access the station by opening the door to the enclosure and entering a truck ID number using the keypad.

F. Hauler Access Station shall include a daylight visible display and outdoor-rated robust keypad. The display shall provide log-on instructions for the hauler and prompt the hauler for additional information, as required.

G. Hauler Access Station shall include a receipt printer and integral light. The printer shall quickly print and cut each receipt and the integral light shall inform the hauler that a receipt has been printed. Each printed receipt shall include the following:

1. Date and Time of Transaction
2. Station ID and Ticket Number
3. Hauler ID number
4. Volume Unloaded
5. Elapsed Time
6. Alarm ID
7. Waste Type

H. Hauler Access Station shall continue to function normally even without a network connection to the office. Hauler transaction data shall be stored in a local solid state drive. If a network connection is established, all transaction data shall be automatically synchronized and stored securely in an IT managed SQL database.

2.12 MANAGEMENT SOFTWARE

A. Management software shall be installed on a site owned PC, physical or virtual. The PC must have the appropriate network configuration to communicate with Hauler Access Station(s). PC system requirements are as follows:

1. Operating System: Windows 7 or later / Windows Server 2008 R2 or newer
2. CPU: Intel Core i5, 2.4 GHz, minimum
3. RAM: 8 GB, minimum
4. Storage: 15 GB, minimum
5. Network: 1 Gbps / 100 Mbps Ethernet connection
6. Cloud Service requirement (if used):
    a. Public static IP address
    b. 10 Mbps or higher bandwidth

B. The software shall be web based with unlimited users, utilizing Microsoft Internet Information Services (IIS). Recommended web browsers: Google Chrome, Mozilla Firefox.

C. The software shall monitor the Hauler Access Station(s) and automatically upload hauler transaction data to the networked PC.

D. An unlimited number of users shall have access to the management software web interface for hauler and data management.

E. Data from each hauler transaction shall be collected and stored in a secure SQL database. The following data shall be collected:

1. Site ID
2. Station ID
3. Ticket Number
4. Hauler ID
5. Date and Time of Transaction
6. Volume Unloaded
7. Additional Process Analyzer Data (if configured)
8. Product Type ID
9. Alarm ID
10. Five (5) additional fields will be available for the administrator to define

F. The software shall be used to configure the hauler's identification method as well as their PIN used at the Hauler Access Station(s).

G. The software shall be used to configure scalable devices communicating with the Hauler Access Station(s), such as:

1. Flow Meters
2. pH Analyzers
3. Conductivity Sensors
4. Acoustic Sensors

H. The software shall allow the facility to periodically initiate an automatic sampler. Samples can be taken automatically for each transaction or periodically for selected trucks. The software will collect data to show specifically which loads were sampled.

I. A user-friendly interface shall be provided to allow the facility to view hauler transaction data and enter/edit information when necessary. The software shall have a built-in sorting tool that allows the user to create multiple data views. The software shall have a "Main Screen" view that displays all transaction data divided into the following sections:

1. Transaction Log
2. Customers
3. Truck Status
4. Customer Balances
5. Link to Reports

J. The software shall allow the facility to define the Hauler Access Station's operating time schedule. If the station is closed, a message will alert the hauler that the station is closed.

K. Customer (Hauler) and Truck Features:

1. The software shall allow the facility to create a list of customers that will be billed for use of the Hauler Access Station(s). The software shall not limit the facility as to the number of customer accounts that can be created.

2. The software shall allow the facility to create multiple truck accounts and link these accounts to the corresponding customers. The software shall not limit the facility as to the number of trucks that can be assigned to each customer.

3. The facility shall be able to enter customer ID numbers, pin numbers, and details regarding the truck including capacity, weight, and vehicle information into the system.

4. Each customer shall receive a Hauler ID number and 4-digit PIN number for each truck. PIN number assignment can be unique per owned truck or common to all owned trucks, depending on the facility and customer preference. The software shall auto-generate customer PIN numbers or shall allow the administrator to manually assign pin numbers to customers.

5. The software shall allow the facility to enable or disable a truck's access privilege. Once disabled, a hauler's access will immediately be denied at all sites. A message shall be displayed at log-in at the hauler station informing the hauler to contact the office.

L. Waste Type Features:

1. The software shall allow the facility to define a list of permitted waste types and an associated rate to be charged per 1000 units of waste unloaded. The software shall allow the facility to define these units (e.g., Gallons, Liters, etc.) The facility shall also be able to set different rates for the same waste type (e.g., Ex. Charging In-county customer vs. out-of-county customer).

2. When accessing the station, the customer shall be prompted at log-in to identify the waste type that shall be unloaded.

M. Status and Alarm Features:

1. The software shall allow the facility to monitor the Hauler Access Station in real-time. The facility shall be able to monitor the current customers/trucks total flow, waste types, valve status, equipment faults, and additional user-defined variables.

2. The software shall allow the facility to monitor alarms at the Hauler Access Station. Alarms make the station unusable or may prevent a hauler from unloading. These alarms include:

a. E-Stop pressed

b. Printer Low on Paper

c. Equipment Fault

d. Storage Tank at High Level

e. Optional User-Defined Alarm (20 Available)

N. Reporting, Billing, and Payment Features:

1. The software shall allow the facility to manage each customer on a debit or credit basis. The facility shall choose whether customers shall pay prior to using the Hauler Access Station or after.

2. The software shall debit account balances automatically and auto-deactivate the truck's access privilege should the customer's balance drop below the set minimum. The facility shall be able to set the minimum.

3. The software shall allow the facility to bill on a truck capacity basis, a metered basis (flowmeter or scale), or by manual entry.

4. The software shall allow the facility to enter payments if required. The total balance shall automatically recalculate once a payment is applied. A customer's account that is deactivated shall be automatically reactivated once money is received.

5. The facility shall be able to use the features of the software to substantiate the data recorded from each transaction and accurately calculate the total cost on a per customer basis.

6. The software shall have multiple pre-formatted reports that will, at a minimum, show activity with daily totals, statements, customer and truck usage. The software shall also allow the facility to generate billing statements that can be exported for accounting use. The reports and billing statements shall be easily exported into PDF, CSV, XLS, and other formats.

PART 3 EXECUTION

3.01 INSTALLATION

A. Contractor shall install complete equipment in accordance with Manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. The general requirements for system testing, check out, initial start-up, certification, and instruction of plant personnel are contained in Section 01 60 00 and Section 01 77 00.

B. Provide services of a factory representative for a minimum of one (1) day (e.g., 8 hours) on-site to inspect, test, and adjust the equipment after installation to verify the mechanical and electrical integrity and conformance to the equipment specifications. Provide written certification that the equipment is properly installed following the initial site visit.

C. Provide services of a factory representative for one (1) day (e.g., 8 hours) on-site to verify the proper operating of the equipment and to instruct Owner's personnel on operation and maintenance.

D. Provide additional services at no cost to the Owner to correct any operational problems as determined by the Engineer or Contractor.

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

WADE TRIM

CLEAR FORM

CERTIFICATE OF SUBSTANTIAL COMPLETION

350-02
(Rev. 04/2019)

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

CHANGE ORDER NO. _____

305.08
(Rev. 04/2019)

CLEAR FORM

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:	ACCEPTED:	ACCEPTED:
By: _____ *Engineer (Authorized Signature)*	By: _____ *Owner (Authorized Signature)*	By: _____ *Contractor (Authorized Signature)*
Date: _____	Date: _____	Date: _____

Change Order becomes effective upon date of final signature.

WADE TRIM

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):

CHANGE IN CONTRACT PRICE	**CHANGE IN CONTRACT TIME**
Select 1 of this requested Proposal:	Select 1 of this requested Change Proposal:
$	Substantial Completion (days): Ready for final payment (days):

Engineer's Decision on Change Proposal:

ENGINEER:	OWNER:	CONTRACTOR:
By: _____ *Engineer (Authorized Signature)*	By: _____ *Owner (Authorized Signature)*	By: _____ *Contractor (Authorized Signature)*
Date: _____	Date: _____	Date: _____

WADE TRIM

CLEAR FORM

☐ CONSTRUCTION CHANGE REQUISITION
☐ WORK CHANGE DIRECTIVE

No. _____

305.05
(Rev. 05/2019)

Prepared By: _____ **Date:** _____

Page: ____ **of** ____

WT Project No.:		**Project Name:**	
Owner / Municipality:			
Owner Project No.:		**Department:**	
Project Location:			
Contractor:		**Subcontractor:**	

Description or Work:

Reason:

Item No.	Description	Unit	Quantity Increase (Decrease)	Unit Price	Amount Increase (Decrease)
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
				Net Cost	**$ 0.00**

Request for Contract Time Extension: ☐ Add _____ Days ☐ Not Applicable

_____ _____ _____ _____

Contractor (Representative) Date Wade Trim (Representative) Date

WADE TRIM

☐ **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

WADE TRIM

CLEAR FORM

FIELD ORDER NO. _____

305.04
(Rev. 04/2019)

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 then ten (10) days after the issuance of said Notice.

_____
Resident Project Representative (Signature)

Non-Compliance Notice Received By Contractor

Received On: _____ By: _____
Date (Signature)

Title: _____

Corrective action to be taken by Contractor: _____

_____

_____

_____ By: _____
Date (Signature)

Owner's Acknowlegement

☐ Accepted ☐ Accepted as Noted ☐ Unacceptable ☐ Pricing

_____

_____

_____ By: _____
Date (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:**	

Item No.	Description of Item	Initials	Date	Actions to be Taken to Close	Verified by	
					Initials	Date

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. Items(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 contractrual 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

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

WADE TRIM

RFI NO. _____

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.

WADE TRIM

CLEAR FORM

REQUEST FOR INFORMATION (RFI) NO. _____
RESPONSE

311-01
(Rev. 04/2019)

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.

CLEAR FORM

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) ☐ 2. Approved as Noted (AN) ☐ 3. Revise and Resubmit (RR) ☐ 4. Not Approved - See Remarks (NA) ☐	None ☐ Confirm ☐ Resubmit ☐

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
PROJECT REPORTS & PROPOSALS

1. SME Geotechnical Evaluation Report
2. MAK Controls Proposal

GEOTECHNICAL EVALUATION REPORT

FLINT WWTP SEPTAGE RECEIVING BUILDING AND PUMP STATION
FLINT, MICHIGAN

SME Project Number: 092936.00
June 2, 2023

SME

2663 Eaton Rapids Road
Lansing, MI 48911-6310

T (517) 887-9181

www.sme-usa.com

June 2, 2023

Mr. Trevor Burke, PE
Wade Trim
500 Griswold, Suite 2500
Detroit, Michigan 48226

Via E-mail: tburke@wadetrim.com

RE: Geotechnical Evaluation
Flint WWTP Septage Receiving Building and Pump Station
4652 Beecher Road
Flint, Michigan
SME Project No. 092936.00

Dear Mr. Burke:

We have completed our geotechnical evaluation for the subject project. This report presents the results of our observations and analyses, our geotechnical engineering recommendations and general construction considerations based on the information disclosed by the borings.

We appreciate the opportunity to be of service. If you have questions or require additional information, please contact me.

Sincerely,

SME

Bradford L. Ewart II, PE
Regional Office Manager / Project Manager

Enclosures: SME Geotechnical Evaluation Report: Dated June 2, 2023

TABLE OF CONTENTS

1. INTRODUCTION

This report presents the results of our geotechnical evaluation for the proposed Septage Receiving Building and Pump Station project at the Wastewater Treatment Plant (WWTP) in Flint, Michigan. We conducted this evaluation in general accordance with the scope of services outlined in SME Proposal P01476.23 dated April 24, 2023, with the exception that one boring was not performed due to access limitations. Prior to mobilization of the drilling crew on May 18, 2023, Mr. Trevor Burke, PE with Wade Trim informed Mr. Brad Ewart, PE with SME that the pump station would be shifted from the southside of the proposed septage receiving building located to just west of the existing Sludge Thickening Building. SME was requested to abandon the boring location at the southside of the existing Sludge Thickening Building and extend both borings to 25 feet below grade. This evaluation was authorized by Wade Trim.

To assist with our evaluation and the preparation of this report, SME was provided with two site plan drawings prepared by HRC titled “City of Flint WTTP (Figure Nos. 1 and 2) with the latest revision date of March 22, 2018 and March 21, 2018, respectively. The site plan drawings included a layout of the existing site features and the proposed septage receiving building and pump station (plan and elevation views); however, the referenced drawings were prepared when the proposed improvements were to be located south of the existing building, but we understand the proposed structures will be the same in type and size, just re-oriented and located to the west of the existing building.

1.1 SITE CONDITIONS

The project site is located on the west side of the existing Sludge Thickening building at the wastewater treatment plant in Flint, Michigan. The location of the site is depicted on the Location Map inset on the Boring Location Diagram (Figure No. 1) included in Appendix A of this report.

The proposed project area currently consists of grass covered areas with a bituminous pavement drive that runs along the west side. An existing storage tank, equipment and buildings are present west of the drive. Based on the provided drawings below, we understand that the existing Sludge Thickening building is supported by a mat foundation. Based on information provided by Trevor Burke, PE with Wade Trim in email on May 31, 2023 and phone conversation on June 1, 2023, we understand that the top of the existing building base slab was measured to be 708.25 feet, and the slab thickness is about 1 foot.

1.2 PROJECT DESCRIPTION

The project will consist of a prefabricated single-story, septage receiving building. Based on the referenced plans, the proposed building will have a footprint of approximately 32-feet by 12-feet with a concrete deck extension on the southwest corner with a footprint of 14-feet by 4-feet. The proposed building will be slab-on-grade and supported on strip footings running along the perimeter of the building. The proposed building will be located on the west side of the existing Thickening Sludge building and will angle outward to the west with the southeast corner being approximately 3 feet away from the existing building. We understand the southside of the proposed building will have a foundation bearing elevation of 711.58 feet and the northside steps down to a foundation bearing elevation of 709.26 feet. Actual structural loads associated with the proposed building was not provided. Therefore, for the preparation of this report, we assumed wall loads of up to 3 kips per lineal foot.

We understand an 8-feet diameter pump station is proposed to be adjacent and south of the proposed building. Based on email conversation with Wade Trim on May 31, 2023, we understand that the proposed bottom of the pump station will bear at 706.33 feet. A 8-inch layer of sand will be placed directly below the proposed pump station foundation. We understand that the pump station will be located at least 13 feet horizontally away from the existing building. Actual structural loads associated with the proposed pump station was not provided. Therefore, for the preparation of this report, we assumed a contact bearing pressure of less than 500 psf throughout the footprint of the proposed pump station.

We expect earthwork will consist of cuts of 10 feet or less will be required to achieve final subgrade levels in the proposed building and pump station areas.

The recommendations of this report are based on the information provided above and the results of the field evaluation. Contact SME if the final design information is different than discussed herein.

2. EVALUATION PROCEDURES

2.1 FIELD EXPLORATION

SME performed two borings (B101 and B102) at the project site on May 19, 2023. The approximate as-drilled locations of the borings are depicted on Figure No. 1. Wade Trim, in conjunction with SME determined the number, depth and locations of the borings prior to drilling based on the project information provided to us. SME used our GPS unit with sub-foot accuracy to stake the borings and obtain the existing ground surface elevation data at the borings locations.

Borings were advanced with a rotary drill rig using continuous-flight augers to the termination depth of the borings to facilitate the collection of soil samples. The borings included soil sampling based upon the Split-Barrel Sampling procedure. Soil samples recovered from the field exploration were delivered to our laboratory for further observation and testing.

Groundwater level observations were recorded during and after completion of drilling and sampling. After recording groundwater level observations, the boreholes were backfilled with auger cuttings. Therefore, long-term groundwater levels are not available from the borings.

2.2 LABORATORY TESTING

The laboratory testing program consisted of visual soil classification (in accordance with ASTM D-2488) of the recovered samples, and moisture content and hand penetrometer testing of portions of the cohesive samples obtained. The Laboratory Testing Procedures in Appendix B provide descriptions of the laboratory tests performed. Based on the laboratory testing, we prepared a soil description and assigned a group symbol to the various soil strata encountered based on the Unified Soil Classification System (USCS).

Upon completion of the laboratory testing, boring logs were prepared which include information on materials encountered, the soil descriptions, penetration resistances, pertinent field observations made during the operations, and the results of the laboratory testing. Each log also includes the existing ground surface elevation as estimated by SME. The boring logs are included in Appendix A. Explanations of symbols and terms used on the boring logs are provided on the attached Boring Log Terminology sheet.

Soil samples are normally retained in our laboratory for 60 days and then disposed, unless instructed otherwise.

3. SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

Surficial topsoil thickness at boring B102 was approximately 10 inches. Topsoil was not observed at boring location B101. Topsoil thickness measurements reported on the boring logs should be considered approximate since mixing of these materials can occur in small diameter boreholes. Therefore, if more accurate thickness measurements are required, we recommend performing additional evaluations such as shallow test pits or hand augers.

Below the surficial topsoil, where encountered, existing fill was encountered in borings B101 and B102 to a depth of about 6 to 6.5 feet below the existing ground surface, corresponding to approximate elevations between 709.9 and 710.7 feet. Topsoil, roots and concrete fragments were observed within the samples of the fill material. The existing fill consisted of both sand and clays soils. The existing sand fill was encountered in a very loose to dense condition, and the existing clay fill exhibited a soft consistency with a moisture content of 29 percent.

Below the existing fill, a natural sand stratum was observed to a depth of about 12 to 13 feet below the existing ground surface. Beneath the natural sand stratum, a hard natural clay stratum was observed to the termination depth of the borings.

It is sometimes difficult to distinguish between fill and natural soils based on samples and cutting from small-diameter boreholes, especially when the fill does not contain man-made materials, debris, topsoil or organic layers, and when the fill appears similar in composition to the local natural soils. Therefore, consider the delineation of fill described above and on the appended boring logs (Refer to Appendix A) approximate only. A more comprehensive evaluation of the extent and composition of the suspect fill could be made by reviewing former site topography plans, aerial photographs, and other historical site records, along with observing test pit observations.

The profile described in this report and included on the logs is a generalized description of the conditions encountered. The stratification depths described in this report and shown on the logs indicate a zone of transition from one soil type to another. They are not meant to delineate exact depths of change between soil types. Soil conditions may vary between or away from the exploration locations. Please refer to the logs for the soil descriptions, and results of the field and laboratory tests at the specific exploration locations.

3.2 GROUNDWATER CONDITIONS

Groundwater was not encountered at boring locations during and/or upon completion of drilling to a termination depth of 25 feet below surface grade. Although not encountered, perched water within the sand stratum may also be present during construction.

In cohesive soils (clays), a long time may be required for the groundwater level in the borehole to reach an equilibrium position. Therefore, the use of groundwater observation wells (piezometers) is necessary to accurately determine the hydrostatic groundwater level within cohesive soils as encountered at this site.

Expect hydrostatic groundwater levels, perched groundwater, and the potential rate of infiltration into excavations to fluctuate throughout the year, based on variations in precipitation, evaporation, run-off, and other factors. The groundwater levels indicated by the borings represent conditions at the time the readings were observed. The actual groundwater levels at the time of construction may vary.

4. ANALYSIS AND RECOMMENDATIONS

4.1 SITE PREPARATION AND EARTHWORK

4.1.1 EXISTING FILL CONSIDERATIONS

Based on information obtained from borings B101 and B102, we consider the existing fill to be uncontrolled and undocumented, and not equivalent to engineered fill that is placed and compacted in a uniform manner. We are not aware, nor have been provided with, records depicting the type of fill material, and if the fill was placed in suitable lifts and to a specified density under the observation of a geotechnical engineer.

There are inherent risks of greater than typical settlement and poor structural performance associated with constructing foundations and floor slabs for proposed structures over uncontrolled and undocumented fills. To provide suitable foundation and slab support, we recommend removing the existing fill within the proposed structure footprints and replacing it with engineered fill.

4.1.2 SITE SUBGRADE PREPARATION

The proposed building and pump station areas, along with other areas to receive engineered fill, must be cleared of existing topsoil, root mats, concrete, asphalt, and other deleterious materials to expose the underlying inorganic subgrade soils. We recommend the clearing and stripping extend a minimum of 5 feet beyond the structure and pavement areas.

After stripping of the site, we expect the existing fill will be exposed and removed within the proposed structure footprints. After the existing fill has been removed, as necessary, we recommend the exposed subgrade be evaluated by SME with hand-operated equipment such as dynamic cone penetrometers and hand augers. Areas of unsuitable subgrade revealed during observations must be mechanically improved (compacted) in-place or removed and replaced with engineered fill.

The exposed subgrade soils are susceptible to disturbance due to weather and activity on-site. Exposed sand subgrade soils are susceptible to disturbance when overly dry and trafficked. Therefore, avoid disturbance of the subgrade and to ensure these soils are suitably prepared prior to the placement of engineered fill. Areas of prepared subgrade may be protected from disturbance during construction by placing a layer of crushed aggregate or crushed concrete over the subgrade. The contractor needs to remove or drain ponded surface water and grade the site to prevent surface water from draining toward, or ponding over the building and pump station footprints and other areas of prepared subgrade.

If the subgrade becomes disturbed during the earthwork operations, it will be necessary to mechanically improve the disturbed subgrade by compacting the soil; removing and replacing the disturbed soils with engineered fill or crushed aggregate.

After the exposed subgrade is evaluated (as described above) and improved as necessary, engineered fill may be placed on the exposed subgrade to establish final design subgrade levels. See Section 4.1.4 of this report for materials and compaction requirements for engineered fill.

4.1.3 SUBGRADE PREPARATION FOR SLABS

We anticipate the final subgrade for the building pad will consist of properly prepared natural sands or clays, or engineered fill placed over properly prepared natural soils. These soils are generally considered suitable for support of grade slabs, provided the subgrade is properly prepared and engineered fill is properly placed and compacted.

We recommend the slab-on-grade subgrade soils be protected from frost action during winter construction. Frozen soils must be thawed and compacted, or removed and replaced prior to slab-on-grade construction. Prior to concrete placement for slabs, the subgrade needs to again be observed and tested to identify areas of subgrade that were disturbed during construction activities and to verify subgrade conditions are suitable for slab support. We recommend proof-rolling the final subgrade. If proof-rolling is not feasible because of access constraints, SME must observe and test the exposed subgrade using density in-place meters and/or other hand-operated equipment such as hand augers and cone penetrometers. Unsuitable subgrade indicated by SME needs to be removed and replaced with engineered fill or chemical modification could also be considered.

We recommend providing a minimum 6-inch thick slab subbase consisting of an approved MDOT Class II granular material to provide a leveling surface for the construction of slabs, and a moisture capillary break between the slabs and the underlying soils. However, the thickness of dense-graded aggregate may need to be increased based on the floor loads for the slabs and to protect the subgrade during construction.

When determining the aggregate thickness, consider the time of year, the condition of subgrade soils during construction, and the type and volume of construction equipment to traffic the prepared subgrade. The aggregate must also be compacted per Section 4.1.4 of this report.

We recommend a vapor barrier be provided below the floor slab if the slab is to receive an impermeable floor finish/seal or a floor covering which would act as a vapor barrier. The location the vapor retarder (relative to the subbase) should be determined by the Architect/Engineer based on the intended floor usage, planned finishes, and in accordance with ACI recommendations.

Floor slabs need to be separated by isolation joints from structural walls to permit relative movement. A minimum of 6-inches of engineered fill is recommended between the bottom of the slab and the top of the shallow spread foundation below.

4.1.4 ENGINEERED FILL REQUIREMENTS

Fill placed within the construction area should be free of frozen soil, organics, construction debris, particle sizes that will hinder compaction, or other deleterious materials. The fill should be spread in level layers not exceeding 9 inches in loose thickness and be compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with the Modified Proctor test. Sand fill should be compacted with a smooth drum vibratory roller or vibratory plate compactors including either walk-behind types, or plate compactors mounted on a backhoe or excavator (hoe-pacs).

Based on the confined and limited areas within the proposed entry area, we do not recommend the existing fills, and natural sands and clays for use as engineered fill. We recommend imported fill meet the gradational requirements of MDOT Class II granular material.

If necessary, coarse crushed aggregate used to backfill undercuts or to stabilize subgrades should consist of a well-graded crushed natural aggregate ranging from 1 to 3 inches in size with no more than 7 percent by weight passing the No. 200 sieve. I n cases where granular engineered fill (e.g. MDOT Class II granular material) will be placed over the coarse crushed aggregate, the surface of the coarse crushed material should be covered with a suitable non-woven geotextile (e.g. Mirafi® 140N or 160N) to prevent migration of the granular materials into the coarser crushed aggregate.

4.2 SHALLOW FOUNDATIONS

4.2.1 SUBGRADE VERIFICATION

To verify suitable subgrade is exposed at the bearing surface of footing excavations, and the maximum net allowable soil bearing pressure is achievable, foundation subgrades must be evaluated and tested during construction. By preparing the geotechnical evaluation report, SME is currently the geotechnical engineer of record for this project and is best-suited to observe and test the foundation subgrades during construction and to verify the recommendations of this report are properly implemented during construction.

4.2.2 SPREAD FOUNDATIONS – PROPOSED BUILDING

Existing fill must be undercut below foundations and replaced with engineered fill or the foundations can be extended to bear on suitable natural soils below. The foundations for the new structures may consist of conventional shallow spread footings provided the site is prepared as recommended in Section 4 and that the existing unsuitable fills at and below the foundation level are removed.

The proposed building and pump station can be supported on conventional shallow spread footings bearing on the natural medium dense to dense sands, natural hard clays, or engineered fill overlying suitable natural soils. Suitable natural soils were encountered below the existing fill. Use a maximum net

allowable soil bearing pressure of 4,000 pounds per square foot (psf) for foundations bearing on the soils described above. The design bearing pressure provided above is based on a minimum factor-of-safety of 3 (for general shear failure).

For bearing capacity and settlement considerations, we recommend continuous (wall) foundations have a minimum width of 18 inches. In cases where structural loads are light, the minimum foundation size criteria may govern the size of the foundation and not the allowable soil bearing pressure.

Total settlements for spread foundations are estimated to be 1 inch or less and differential settlements for foundations supporting similar loads are estimated to be about one-half of the total settlement, or less. This settlement estimate is based on the boring information, recommended maximum net allowable soil bearing pressures, estimated structural loads, our experience with similar structures and soil conditions, along with field verification of suitable bearing soils by SME.

4.2.3 MAT FOUNDATION – PROPOSED PUMP STATION

A relatively rigid, reinforced concrete mat foundation bearing on medium dense to dense natural sands or on engineered fill placed over suitable natural soils, is anticipated for support of the proposed pump station. For mat foundations situated on suitable soils discussed above, a maximum net allowable soil bearing pressure of 4,000 pounds per square-foot (psf) is recommended for design.

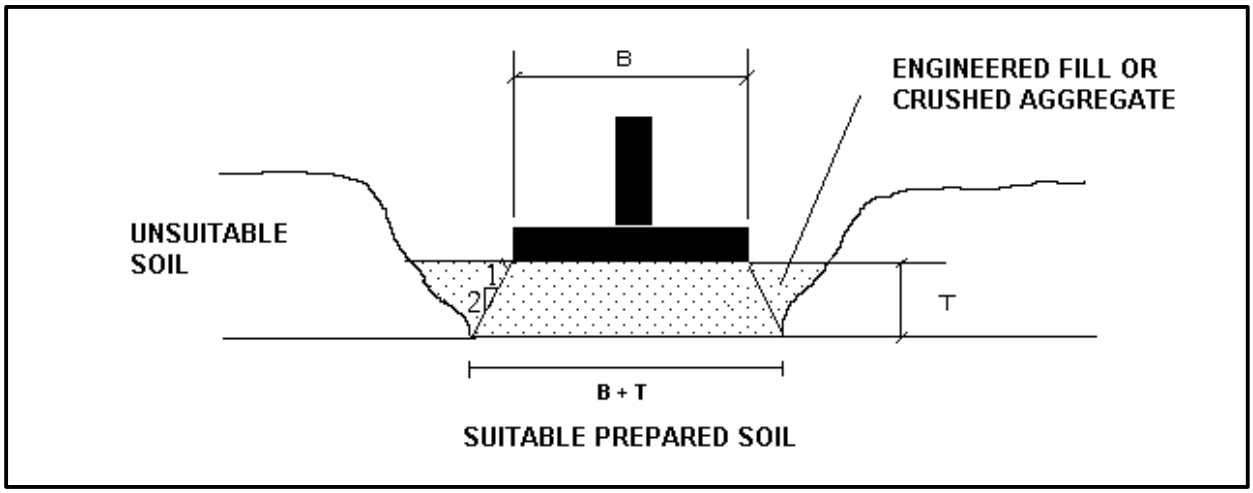
If subgrade reaction theory is utilized to design the mat foundation, a vertical modulus of subgrade reaction of 150 kips per cubic-foot (kcf) may be utilized in the analysis. The recommended value of subgrade modulus is expected to apply to the conditions below the mat and is based on correlations with soil type developed from plate load tests conducted using a 1-foot square plate.

For relatively large and rigid foundations (such as mats), the design of the foundation is typically not controlled by allowable soil pressure because the allowable bearing pressure is usually much larger than the net static contact pressure below the foundation. Based on the pump contact pressure discussed in Section 1.2, and assuming this weight is distributed evenly over the mat (i.e., the mat is considered to be rigid), we estimate total settlement for the mat foundation used to support the pump station will be less than about ½-inch. Since the mat foundation is expected to be relatively rigid (stiff), we anticipate differential settlements across the mat foundation will be relatively small and generally less than about one-half the total settlement (for a relatively rigid mat). Deflections across the mat due to the loads implied by the silos are a function of the stiffness of the mat, the stiffness of the supporting subgrade, and the magnitude and locations of the applied loads. An analysis of the deflections across the mat due to the applied loads is typically performed by the structural engineer using an analytical computer program. However, we expect such deflections will be relatively small for the anticipated loads.

4.2.4 FOUNDATION CONSTRUCTION

Unsuitable soils that cannot be improved in-place, should be undercut to expose suitable natural soils. Where undercutting is necessary, foundations can be constructed at the bottom of the undercut, or the design foundation bearing elevation can be re-established by placing compacted engineered fill or crushed aggregate. The foundation undercuts should be oversized laterally and backfilled with granular engineered fill or crushed aggregate as shown on the *Typical Foundation Undercutting Diagram* below.

TYPICAL FOUNDATION UNDERCUTTING DIAGRAM:



Foundations should be situated a minimum of 42 inches below final site grade. The foundations and proposed bearing soils should be protected from freezing during construction if work occurs in the winter months.

SME understands that the existing Sludge Thickening building has a base slab that bears at approximately 707.25 feet. In general, foundations at the interface between the existing building or pump station should bear at the same elevation. New foundations may cause additional settlement of existing adjacent foundations because of stress overlap. SME can assist the project design team by reviewing these conditions (if any). Bearing levels for new foundations can be established at certain distances from the existing building foundations, depending on the distance between the two bearing levels. As a guideline, foundations should be situated at a relative vertical level no greater than the horizontal distance between the foundations (i.e., a 1 to 1 slope between the edges of adjacent foundations). For reasons of constructability, we recommend limiting vertical “steps” to 1 foot for every 3 horizontal feet.

For frost heave considerations, vertical excavation side-walls must be maintained during foundation concrete placement and the side walls must not be allowed to “mushroom out” near the top. If vertical earthen side-walls cannot be maintained, it will be necessary to slope back the foundation excavations and form foundation side-walls to maintain vertical faces for foundations and reduce the potentially adverse effects resulting from frost heave. Caved soils must be suitably removed from the foundation bearing surfaces before placing concrete.

4.3 BELOW-GRADE WALLS AND DRAINAGE

The project includes permanent below-grade walls for the pump station structure. We recommend the below-grade wall backfill immediately behind or against the wall (recommended to extend a minimum of 24 inches behind the wall) consist of MDOT Class II granular material. To limit water infiltration into the granular backfill behind the wall, the upper 2 feet of the backfill should consist of clay. Below-grade wall backfill should be compacted to a minimum of 95 percent of the maximum dry density as determined by the Modified Proctor test. Even if structures will not be constructed directly above the wall backfill, this level of compaction is recommended to prevent subsidence and associated surface drainage problems adjacent to the walls. Care should be exercised during compaction of the wall backfill to avoid overstressing the walls. If required, walls must be designed to accommodate the additional stresses associated with operating compaction equipment adjacent to the wall.

The below-grade walls are expected to be rigid walls or restrained so they do not rotate sufficiently to permit the lower active earth pressure (Ka) condition to be reached. For rigid walls backfilled with a free-draining granular material and a level finish surface behind the wall, we recommend an at-rest lateral earth pressure coefficient (K0) of 0.5 and an at-rest equivalent fluid pressure of 55 pounds per cubic foot (pcf) for design.

Additional lateral pressures due to surcharge loading (nearby structures and equipment, roadway traffic, etc.) must be added to the above lateral earth pressures for design. Surcharge loads need to be modeled as a uniform pressure distribution applied to the entire wall height. We recommend using a horizontal coefficient for at-rest conditions, anticipating the below-grade walls will be held rigid, to calculate loads on walls due to surcharges.

The earth pressures presented above are for a drained backfill. To reduce the potential for the build-up of hydrostatic pressure behind below-grade walls, we recommend permanent edge drains be installed along the base of the perimeter of the below-grade walls. The perimeter edge drains should consist of a minimum 6-inch-diameter perforated plastic drain pipe, wrapped with a filter fabric and surrounded by 6 inches of filter material, such as pea gravel (MDOT 34G or MDOT 34R), wrapped with a filter fabric. The drains should be discharged into a sump and pumping system, or to a gravity drainage outlet if feasible. We recommend the design include provisions for access to the drains for cleaning and maintenance. In addition, positive surface drainage should be re-established away from the proposed building and from exterior below-grade walls. Roof downspouts should not be discharged onto the ground surface above below-grade walls.

4.4 SEISMIC SITE CLASSIFICATION

Based on the subsurface information obtained from the borings to a maximum depth of 25 feet, seismic site Class D applies to this site in accordance with the 2015 MBC referencing Table 20.3-1 in ASCE Standard ASCE/SEI 7-10.

4.5 CONSTRUCTION CONSIDERATIONS

The depth of the existing fill encountered in the borings could vary between or away from the boring locations. We recommend a contingency be included in the construction budget to address improvement of the existing fill and undercutting and replacement of unsuitable existing fill. Unit prices for this work should be obtained from earthwork contractors, and actual quantities associated with this work documented during construction.

Significant groundwater seepage is not expected to be encountered in excavations above elevation 692 feet. However, water from precipitation, surface runoff, or perched groundwater source(s) could be encountered at elevations above 692 feet. Where natural granular soils are exposed, perched groundwater may drain into the underlying subgrade. The concentration of clay in the subgrade will affect the rate of infiltration and the time required for the subgrade to dry after a precipitation event. If water accumulates in excavations above elevation 692 feet, we expect these accumulations can be controlled using standard sump pit and pumping procedures. A working surface of either crushed aggregate or crushed concrete may be required to protect the exposed subgrade where seepage is encountered.

The near-surface soils present at the site are moisture sensitive and susceptible to disturbance if they become wet and are trafficked by construction equipment. It will likely be more difficult and costly to attempt construction at this site during periods of seasonally cooler and/or wet weather. The warmer summer months will be the optimal time period to perform earthwork activities at this site in order to reduce disturbance of the existing soils, and the need for undercutting of disturbed materials and subgrade remediation. If subgrade preparation occurs during periods of adverse weather, chemical subgrade modification or stabilization could help reduce subgrade disturbance.

Exposed sand subgrade soils are susceptible to disturbance when overly dry and trafficked. Therefore, to reduce the potential of subgrade disturbance across the site, construction traffic should be restricted to staging areas, and should not randomly traffic the site.

The contractor must protect adjacent existing buildings, equipment, utilities, and roadways during the construction of the proposed building, pump station and site improvements. During the excavating and compacting operations, excessive vibrations should not cause settlement of the existing buildings, utilities, and roadways, and the contractor should avoid undermining existing buildings, utilities, and roadways. Excavations should not extend below existing foundations without first properly underpinning

or shoring the existing foundations. In areas where there is insufficient space to temporarily slope back excavations in accordance with applicable regulations, temporary earth retention systems will be required during construction. Underpinning, shoring and earth retention systems should be designed by a qualified professional engineer, and installed by a contractor experienced with construction of these systems.

The contractor must provide safely sloped excavations or an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. If material is stored or heavy equipment is operated near an excavation, use appropriate shoring to resist the extra pressure due to the superimposed loads.

Handling, transportation, and disposal of excavated materials and groundwater should be performed in accordance with applicable environmental regulations.

5. SIGNATURES

REPORT PREPARED BY:

Tyler L. Stephenson, EIT
Project Engineer

REPORT REVIEWED BY:

Andrew T. Bolton, PE
Senior Consultant

APPENDIX A

BORING LOCATION DIAGRAM (FIGURE NO. 1)
BORING LOG TERMINOLOGY
BORING LOGS (B101 AND B102)

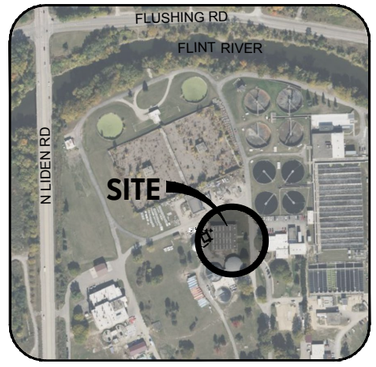
N
W E
S

0' 40' 80'

GRAPHIC SCALE: 1" = 40'

LEGEND

APPROXIMATE BORING LOCATION



LOCATION MAP

NOT TO SCALE

N
W E
S

NOTE:
1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO WITH AN IMAGE DATE OF 07-03-2021.

SME
www.sme-usa.com

Project
FLINT WWTP SEPTAGE RECEIVING BUILDING AND PUMP STATION

Project Location
4652 BEECHER ROAD, FLINT, MICHIGAN

Sheet Name
BORING LOCATION DIAGRAM

No.	Revision Date

Date 06-01-2023
CADD CRC
Designer TLS
Scale AS NOTED
Project 092936.00
Figure No. 1

PLOT DATE: Jun 02, 2023 - 1:22pm - cindy.rocha-ceron \\sme-inc\pz\WIP\092936.00\CAD\Design Files\BLD\Rev1\092936.00-BLD.dwg

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL
(more than 50% of material is larger than No. 200 sieve size.)

GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravel (Less than 5% fines)	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)	GM	Silty gravel; gravel-sand-silt mixtures
		GC	Clayey gravel; gravel-sand-clay mixtures
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sand (Less than 5% fines)	SW	Well-graded sand; sand-gravel mixtures, little or no fines
		SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)	SM	Silty sand; sand-silt-gravel mixtures
		SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL
(50% or more of material is smaller than No. 200 sieve size)

SILT AND CLAY Liquid limit less than 50%		ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
		CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
		OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater		MH	Inorganic silt of high plasticity, elastic silt
		CH	Inorganic clay of high plasticity, fat clay
		OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL		PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

Topsoil, Void, Sandstone, Asphalt, Glacial Till, Siltstone, Aggregate Base, Coal, Limestone, Concrete, Shale, Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……GW, GP, SW, SP
More than 12 percent……GM, GC, SM, SC
5 to 12 percent……Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

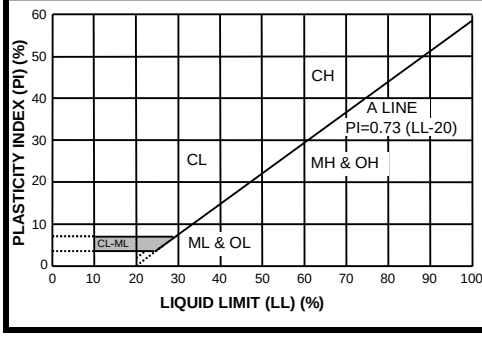
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.0074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressure Meter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

DESCRIPTION OF RELATIVE QUANTITIES

The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines:

Trace	–	particles are present but estimated to be less than 5%
Few	–	5 to 10%
Little	–	15 to 25%
Some	–	30 to 45%
Mostly	–	50 to 100%

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	N_{60} (N-Value) (Blows per foot)
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	Over 81

Cohesive Soils

Consistency	N_{60} (N-Value) (Blows per foot)	Undrained Shear Strength (kips/ft^2)
Very Soft	<2	0.25 or less
Soft	2 - 4	> 0.25 to 0.50
Medium	5 - 8	> 0.50 to 1.0
Stiff	9 - 15	> 1.0 to 2.0
Very Stiff	16 - 30	> 2.0 to 4.0
Hard	> 30	> 4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N60 values as reported on boring logs represent raw N-values corrected for hammer efficiency only.

6/2/23 12:32:27 PM

BORING B101

BORING DEPTH: 25 FEET

PROJECT NAME: Flint WWTP Septage Receiving Building
PROJECT NUMBER: 092936.00
CLIENT: Wade Trim, Inc.
PROJECT LOCATION: Flint, Michigan

DATE STARTED: 5/19/23 **COMPLETED:** 5/19/23 **BORING METHOD:** Hollow-stem Augers
DRILLER: DW (Strata Drilling) **RIG NO.:** CME 45-Truck **LOGGED BY:** ARC **CHECKED BY:** BLE

ELEVATION: 716.4± FT NAVD 88

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
715	0	FILL- Fine to Medium SILTY SAND with Gravel- Few Clay- Occasional Topsoil Layers, Roots and Concrete Fragments- Brown and Dark Brown- Moist- Medium Dense (SM)	SB1	18	3 4 4	Cobbles encountered from 0 to 6.5 feet.
	3.5 (712.9)					
		FILL- Sandy LEAN CLAY- Frequent Sand Seams- Occasional Topsoil Layer and Roots- Brown- Soft (CL)	SB2	15	2 2 1	Sample SB2 was too disturbed to perform a shear strength test.
710	5		SB3	2	2 6 10	
	6.5 (709.9)					
		Fine to Coarse SILTY SAND with Gravel- Brown- Moist- Medium Dense to Dense (SM)	SB4	12	9 18 23	
705	10					
	12.0 (704.4)					Driller reported cobbles from 12 to 15 feet.
			SB5	15	18 25 39	
700	15	LEAN CLAY with Gravel- Occasional Sand Seams- Gray- Hard (CL)				
			SB6	12	16 27 39	
695	20					
			SB7	18	9 16 16	
	25.0 (691.4)	END OF BORING AT 25.0 FEET.				
690	25					
	30					

HAMMER EFFICIENCY: 79%
DATE: 4/6/2022
N_{60} -- ○

DRY DENSITY (pcf) -- ■ (90 100 110 120)
MOISTURE & ATTERBERG LIMITS (%) (PL MC LL; 10 20 30 40)

SHEAR STRENGTH (KSF) (1 2 3 4)
▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)

SPT N-values: 11, 4', 29, 21, 54, 84, 10, 4.5+, 87, 8, 4.5+, 42, 7, 4.5+

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. A Leica hand-held GPS unit was used to collect the approximate latitude, longitude, and ground surface elevation.

6/2/23 12:32:28 PM

BORING B102

BORING DEPTH: 25 FEET

PROJECT NAME: Flint WWTP Septage Receiving Building
PROJECT NUMBER: 092936.00
CLIENT: Wade Trim, Inc.
PROJECT LOCATION: Flint, Michigan

DATE STARTED: 5/19/23 **COMPLETED:** 5/19/23 **BORING METHOD:** Hollow-stem Augers
DRILLER: DW (Strata Drilling) **RIG NO.:** CME 45-Truck **LOGGED BY:** ARC **CHECKED BY:** BLE

ELEVATION: 716.7± FT NAVD 88

ELEVATION (FEET)	DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
715.9	0.8	10 Inches of TOPSOIL				
715	0	FILL- Fine to Medium SILTY SAND- Trace Gravel- Occasional Clay Layers and Topsoil Seams- Brown and Dark Brown- Moist- Very Loose to Medium Dense (SM)	SB1	8	1 0 1	
	5		SB2	15	2 16 14	
710.7	6.0					
710		Fine to Coarse SILTY to CLAYEY SAND with Gravel- Occasional Clay Seams- Brown- Moist- Dense to Medium Dense (SM/SC)	SB3	12	13 15 12	Driller reported cobbles from 6 to 13 feet.
	10		SB4	18	9 11 11	
703.7	13.0					
705		LEAN CLAY- Trace Gravel- Frequent Silt and Sand Seams- Gray- Hard (CL)	SB5	15	21 36 37	
	15					
700			SB6	12	15 30 40	
	20					
695			SB7	18	11 14 21	
691.7	25.0	END OF BORING AT 25.0 FEET.				
690	25					
	30					

HAMMER EFFICIENCY: 79%
DATE: 4/6/2022
N_{60} -- ○

DRY DENSITY (pcf) -- ■ (90 100 110 120)
MOISTURE & ATTERBERG LIMITS (%) (PL MC LL) (10 20 30 40)

▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)
SHEAR STRENGTH (KSF) (1 2 3 4)

GROUNDWATER & BACKFILL INFORMATION

GROUNDWATER WAS NOT ENCOUNTERED

BACKFILL METHOD: Auger Cuttings

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. A Leica hand-held GPS unit was used to collect the approximate latitude, longitude, and ground surface elevation.

APPENDIX B

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT
GENERAL COMMENTS
LABORATORY TESTING PROCEDURES

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440º C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a ½-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool ½ inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.

City of Flint

Flint, Michigan

Waste Unloading Station

SCADA Integration

MAK-2306

MAK: Michael Lancina
MAKcontrolsLLC@gmail.com
(734) 770-8785

WadeTrim: Trevor Wagenmaker
twagenmaker@wadetrim.com
(810) 235-2555

MAK CONTROLS

ELECTRICAL ENGINEERING | CONTROLS DESIGN
PANEL FABRICATION | PROJECT MANAGEMENT

MAK-2306 Waste Unloading
System Features & Functions

Scope

Provide a budgetary estimate of engineering support to integrate the new Waste Unloading Station controls (provided by others) into the existing plant SCADA system.

Justification

A new waste tanker unloading station is planned ajacient to the Digester/East Storage Tank. The new equipment will require an ethernet connection to the plant network - via the PCS panel switch.

The new packaged controls (by others) will include a small PLC/HMI panel. This panel will be tied, via Ethernet, to the plant network.

Operator screens (expected max three) will be replicated from the new system into the plant-wide SCADA.

Description

In general, system commissioning support and engineering support during construction will be provided as necessary.

The new panel will require an Ethernet connection to the plant network. There is a fiber drop in the PCS panel. The local network switch (8-port + FO) is full, in poor condition and will need to be relpaced.

A new network 16-port switch, with fiber interface, will be supplied in a small panel to be slaved to the PCS panel (installation by others).

The new unloading station HMI will have XX screens for control and monitoring. Screens that don't require local presence (safety) will be replicated into the plant's Allen-Bradley FactoryTalk View system

System generated Alarms/Events will be ported into the plant HMI.

Payment Terms

The following is a budgetary proposal for this project:

$11,795.00

MAK-2306 Waste Unloading
Bill of Materials

Qty	Item	Manufacturer	Description
1	Enclosure for Ethernet Switch	SCE	12" x 10" x 8", NEMA 4x
1	Enclosure Subpanel	SCE	Subpanel, Bent
1	Ethernet Switch	Hirschmann	14 x 10/100Base-TX, RJ45 and 2 x 100Base-FX Multimode Fiber, SC
	Miscellaneous Hardware		
1	CCS Services Calc	MAK Controls	engineering services
	Engineering Services		

MAK-2306 Waste Unloading
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 or 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 charges, etc.

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: