CITY OF FLINT, MICHIGAN
DEPARTMENT OF PURCHASES & SUPPLIES

PROJECT MANUAL FOR

DORT PUMP STATION REHABILITATION

City of Flint Bid No. 21000572

November 6th, 2020

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CITY OF FLINT

Department of Purchases & Supplies

Sheldon Neeley
Mayor

Joyce A. McClane
Purchasing Manager

INVITATION TO BID

OWNER:

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

Project Name: Dort Pump Station Rehabilitation
Project No. 21000572

SCOPE OF WORK:

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

Dort Pump Station Rehabilitation

per the attached requirements.

If your firm is interested in providing the requested services, please submit one (1) original, one (1) copy, and one (1) unbound copy of your bid in a sealed envelope to the City of Flint, Department of Purchases by **Thursday, December 3, 2020 @ 3:00 PM EST.** The outside of the envelope should clearly identify the project name and number, and the name and address of the Bidder. Please note: all bids received after 3:00 PM (EST) will not be considered. Faxed bids to the Purchasing Department will not be accepted. Bidding Documents shall meet requirements set forth in Specification Section 00 21 13 Instructions to Bidders.

A mandatory ZOOM pre-bid meeting will be held on **Wednesday, November 18 , 2020 @ 10:00 AM EST** . This will be the only opportunity that potential contractors will be able to have direct conversation with both the Purchasing Department and the Flint Water Quality Improvement Program Management Team. Potential contractors wishing to attend this Zoom shall contact Danielle Sutton at DLZ, email address dsutton@dlz.com to obtain a meeting invitation to the Zoom Meeting.

All questions regarding interpretation and clarification of the bidding documents shall be submitted in writing to Joyce A. McClane at jmcclane@cityofflint.com by 5:00 PM EST November 20, 2020.

A bid guaranty or a cashier's check in the amount of 5% of the total bid must be submitted with the bid. Please note: cashier' check must be payable to Treasurer, City of Flint.

All additional bid documents, requirements, addendums, specifications and plans/drawings (if

utilized) are available on the Purchasing page of the City of Flint's web site at https://www.cityofflint.com/finance/purchasing/ under "open bids" and the specific bid or proposal number assigned to this notice.

Anticipated Bid Submission Schedule:

Date Released/Bid Posted to City's Website:	Wednesday, November 4, 2020
Bid Advertisement:	Sunday, November 8, 2020
Pre-bid Meeting:	Wednesday, November 18, 2020 at 10:00 AM EST
Final Date for Questions:	Friday, November 20, 2020 at 5:00 PM EST
Final Addendum:	Tuesday, November 24, 2020 by 5:00 PM EST
Bid Due Date:	Thursday, December 3, 2020 at 3:00 PM EST
Bid Review:	Monday, December 7, 2020
Anticipated Finance Committee/ City Council Approval:	Monday, December 21, 2020
Anticipated Contract Execution:	Monday, January 4, 2021
Anticipated Notice to Proceed:	Wednesday, January 6, 2021

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

Submit to City:
One (1) printed, signed, original proposal and addenda
One (1) electronic copy of the proposal and addenda on flash drive or readable disk
One (1) printed, signed, copy of the proposal and addenda (unbound)

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

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

Joyce A. McClane
810766-7340
jmcclane/g›cityofflint.com

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

Sincerely

Joyce A. McClane, Purchasing Manager

Dort Pump Station Rehabilitation

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END OF SECTION

SECTION 00 21 13

INSTRUCTION TO BIDDERS

ARTICLE 1 – DEFINED TERMS

1.1 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

B. *Bidder* - The individual or entity who submits a Bid directly to Owner.

C. *Successful Bidder* - A responsible Bidder submitting a responsive Bid to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

D. *Biding Documents* – Complete set of general conditions, specifications, details, and appendices as identified in the accompanying Table of Contents, as well as any clarifications and addendum issued for this Bid by the City of Flint.

E. *Owner* – City of Flint, MI

F. *Engineer* - City of Flint or it's designee

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.1 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Invitation to Bid may be obtained through the Owner's website *www.cityofflint.com/purchasing* under "open bids".

2.2 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

2.4 Deposit on Drawings and Documents: No deposit is required.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.1 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be called for below.

A. The address and description of the Bidder's place of business.

B. The number of years engaged in the contracting business under the present firm name, and the name of the state where incorporated.

C. A list of the property and equipment available to the Bidder to evaluate if the Bidder can complete the Work in accordance with the Bidding Documents.

D. A financial statement of the Bidder showing that the Bidder has the financial resources to meet all obligations incidental to the Work.

E. The Bidder's performance record giving the description, location, and telephone numbers of similar projects constructed in a satisfactory manner by the Bidder. Bidder shall provide at least five reference projects. Refer to Bid Form, Exhibit F.

F. A list of projects presently under contract, the approximate contract amount, and percent of completion of each.

G. A list of contracts which resulted in law suits.

H. A list of contracts defaulted.

I. A statement of the Bidder indicating whether or not the Bidder has ever filed bankruptcy while performing Work of like nature or magnitude.

J. A list of officers of the firm who, while in the employ of the firm or the employ of previous firms, were associated with contracts which resulted in lawsuits, contracts defaulted or filed for bankruptcy.

K. The technical experience of personnel guaranteed to be employed in the responsible charge of the Work stating whether the personnel have or have not performed satisfactorily on other contracts of like nature and magnitude or comparable difficulty at similar rate of progress.

L. Such additional information as will assist Owner in determining whether the Bidder is adequately prepared to fulfill the contract.

3.2 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

3.3 Ability and Experience of Bidder:

A. No award will be made to any bidder who cannot satisfy the Owner that he has sufficient ability and experience in this class of work and sufficient capital and plant (equipment and labor) to enable him to prosecute and complete the Work successfully within the time named. The Owner's decision or judgment on these matters shall be final, conclusive, and binding.

B. The Owner may make such investigations as it deems necessary, and the Bidder shall furnish to the Owner, under oath if so required, all such information and data for this purpose as the Owner may request.

ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.1 *Subsurface and Physical Conditions:*

A. No information regarding existing underground facilities is available.

4.2 *Underground Facilities*

A. Original construction drawings are available for review by the Contractor.

4.3 *Hazardous Environmental Condition*

A. No information regarding hazardous environmental conditions is available.

4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 4.06 of the General Conditions.

4.5 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.6

A. Reference is made to Article 7 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.

B. Paragraph 6.13.C of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.7 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

D. consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;

E. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

F. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

G. correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;

H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.8 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and

the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE

5.1 Bidders are required to attend and participate in a pre-Bid conference as scheduled in the Invitation to Bid. Representatives of Owner and Engineer will be present to discuss the Project. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 – SITE AND OTHER AREAS

6.1 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents.

6.2 All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

6.3 The Contractor shall not work on property requiring obtaining of an easement until the Owner has obtained the necessary easement.

6.4 The Contractor shall have no claim for additional compensation or damage on account of any delay in obtaining the necessary easements.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.1 All questions about the meaning or intent of the Bidding Documents are to be submitted to Joyce McClane, City of Flint, Department of Purchases and Supplies in writing. Interpretations or clarifications considered necessary by Owner in response to such questions will be issued by Addenda posted to the Owner's website *www.cityofflint.com/purchasing* under this proposal number. Questions received after 5:00 PM EST on Friday, November 20, 2020 will not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.2 The Owner will set forth as Addenda, which shall become a part of the Contract Documents, such questions received as above provided as in his sole judgment are appropriate or necessary and his decision regarding each. Owner shall post addenda to the Owner's website *www.cityofflint.com/purchasing* under this proposal number.

7.3 The Contractor agrees to use the products and methods designated or described in the Specifications as amended by the Addenda.

ARTICLE 8 – BID SECURITY

8.1 A Bid must be accompanied by Bid security made payable to Owner in amount of 5% of the base bid in the form of a certified cashier's check or a Bid Bond issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General Conditions.

8.2 The Bid security of the Successful Bidder(s) will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider the Bidder to be in default and annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.

Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving an award may be retained by Owner until the earlier of 7 days after the Effective Date of the Agreement or 60 days after the Bid opening, where upon the Bid security furnished by such Bidders will be returned.

8.3 Bid security of the other Bidders whom Owner believes do not have a reasonable chance of receiving the award and who furnished certified checks will have checks returned within 60 days after the Bid opening. Bond forms will be returned upon request.

ARTICLE 9 – CONTRACT TIMES

9.1 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement

ARTICLE 10 – LIQUIDATED DAMAGES

10.1 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.1 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 – BASIS OF DESIGN

12.1 *Basis of Design*

A. Unless otherwise indicated, design of this Project is based upon the material or Supplier's equipment named first in the list of manufacturers in the Specifications. Engineer has performed an evaluation of other listed manufacturers for compliance with the requirements of the Contract Documents. When other manufacturers are listed, Contractor may be required to make modifications or adjustments, at Contractor's expense, to coordinate the installation of the furnished equipment with associated elements of Work, such as piping and electrical connections, or support and mounting provisions.

ARTICLE 13 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

13.1 If the Bidding Documents require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute without any increase in the Bid.

13.2 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.6 of the General Conditions.

13.3 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 14 – PREPARATION OF BID

14.1 The Bid Form is included with the Bidding Documents. Additional copies may be obtained from the Engineer.

A. All blanks on the Bid Form shall be completed in ink and Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form.

B. A Bid price shall be indicated for each bid item listed therein. In the case of optional alternatives, the words "No Bid," "No Change," or "Not Applicable" may be entered.

C. The Bid shall contain an acknowledgement of the receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

D. Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

E. All names shall be printed in ink below the signatures.

F. It is the responsibility of the Bidder to submit a neat, accurate, and complete Bid using the forms provided in Bid documents.

14.2 The Bidder, when signing the Bid(s) shall meet the following requirements:

A. A Bid by an individual shall show Bidder's name and Bidder's official address.

B. A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature) accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

C. A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

D. A Bid by a joint venture shall be executed by each joint venture in the manner indicated on the Bid form. The official address of joint venture shall be shown.

E. A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

14.3 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state of Michigan, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state Contractor license number, if any, shall also be shown on the Bid form.

ARTICLE 15 – BASIS OF BID; COMPARISON OF BIDS

15.1 *Unit Price*

A. Bidders shall submit a Bid on a unit price basis for each Unit Price Work item in the Bid Form.

ARTICLE 16 – SUBMITTAL OF BID

16.1 The Bid Form is to be completed and submitted with the Bid security and the following documents:

A. See Article 7 of Section 00 41 13 entitled "Bid Form" for a list of documents required to be submitted with the Bid.

1. A Bid shall be submitted no later than the date and the time prescribed and at the place indicated in the Invitation to Bid and shall be enclosed in a plainly marked package with the Project title and number, the name and address of the Bidder, and shall be accompanied by the Bid security and other required documents. If the Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." No oral, facsimile, or telephonic bids will be accepted. A mailed Bid shall be addressed to the address indicated on the Bid Form. All Bids received will be time stamped by the Department of Purchases and Supplies.

B. OWNER may consider informal any Bid not prepared and submitted in accordance with the provisions hereof.

C. Bidders are cautioned that it is the responsibility of each individual bidder to assure that his bid is in the possession of the responsible official or his designated alternate prior to the stated time and at the place of the Bid Opening. Owner is not responsible for bids delayed by mail and/or delivery services, of any nature.

ARTICLE 17 – MODIFICATION AND WITHDRAWAL OF BID

17.01 Bids may be withdrawn prior to opening of the Bids upon written request of the Bidder, or the personal appearance of the Bidder or Bidder's designated representative. Bids may not be modified and resubmitted prior to the Bid opening time if a Bidder claims a mistake, omission, or error in the preparation of the Bid. Withdrawn Bids may not be resubmitted unless the Work is re-advertised and rebid upon such advertisement.

ARTICLE 18 – OPENING OF BIDS

18.01 Bids will be opened at the time and place designated by the Owner and, unless obviously non-responsive, read aloud publicly.

ARTICLE 19 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

19.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 20 – EVALUATION OF BIDS AND AWARD OF CONTRACT

20.1 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder.

Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

20.2 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

20.3 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

20.4 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

20.5 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

20.6 In the event that there is a discrepancy in the Bid between the lump sum or unit prices written in words and figures, the prices written in words shall govern.

20.7 The Owner reserves the right to decrease the scope of the work to be done under this contract and to omit any work in order to bring the cost within available funds. To this end, the Owner reserves the right to reduce the quantity of any items or omit all of any items as set forth in the Bid, either prior to executing the contract or at any time during the progress of the work. The Owner further reserves the right, at any time during the progress of the work, to restore all or part of any items previously omitted or reduced. Exercise by the Owner of the above rights shall not constitute any ground or basis of claim for damages or for anticipated profits on the work omitted.

20.8 If the Contract is to be awarded, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project. Contracts shall be awarded to the responsible firm whose Bid is most advantageous to the program, with price and other factors considered. Through formal Bid evaluations, the Owner will evaluate the bidders complete Bid, including additional factors and considerations but not limited to approach and methodology, performance history and references, financial ability, and adherence to regulatory compliancerequirements.

20.9 Responsive and Responsible Bid: Responsiveness is determined by the examination of the Bid to ensure that it conforms to the stated requirements of the Bidding Documents (i.e., the Bidder provided a Bid Bond in the proper amount; the Bidder included required documentation in its Bid; etc.). Responsibility is evaluated by measuring the apparent

ability of the contractor to successfully meet the requirements of the Contract Documents considering, but not limited to:

A. Adequate financial resources to perform the Contract in entirety

B. Ability to meet the requirements of the Contract Documents

C. Satisfactory record of performance on other contracts of similar size and scope

D. Necessary staffing, organization, experience, operational controls, and technical skills

E. Necessary production, construction, and technical equipment facilities

20.10 The Owner reserves the right to omit certain items in their entirety and other items in part as set forth in the Bid.

ARTICLE 21 – CONTRACT SECURITY AND INSURANCE

21.01 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 22 – SIGNING OF AGREEMENT

22.1 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of signed counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within 20 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner.

22.2 The Notice of Award will be issued within 120 days after the Bids are received.

ARTICLE 23 – WAGE RATES

23.1 Each Contractor or Subcontractor performing Work on this Project shall comply in all respects with all laws governing the employment of labor, Social Security, and Unemployment Insurance of both the state and federal government. There shall be paid each employee engaged in Work under this Contract at the Site of the Project, the minimum wage for the classifications of labor employed. Bidders shall make their own investigation locally and satisfy themselves as to availability of labor.

23.2 Not less than the prevailing wage rates on public Work as established by the U.S. Department of Labor and the State in which Work is to be done shall be paid. Wages and rates are also subject to the provisions of the Davis-Bacon Act.

ARTICLE 24 – SALES AND USE TAXES

24.1 Provisions for the Bidder's responsibilities for sales and other taxes appear in Paragraph 6.10 of the General Conditions and as supplemented in the Supplementary Conditions. Bidder shall investigate the statutory requirements for payment of sales taxes and if required shall include the tax in the Bid.

24.2 If investigation indicates tax exempt status, Contractor(s) shall forward this information to its Suppliers in order that the sale of such materials and equipment be properly recorded as a tax-exempt sale.

24.3 Contractor and any subcontractor engaged in this contract shall withhold from each payment to his employees the City income tax on all of their compensation subject to tax, after giving effect to exemptions, as follows:

A. Residents of the City: At a rate equal to 1% of all compensation paid to the employee who is a resident of the City of Flint.

B. Non-residents: At a rate equal to ½% of the compensation paid to the employee for work done or services performed in the City of Flint.

These taxes shall be held in trust and paid over to the City of Flint in accordance with City ordinances and State law. Any failure to do so shall constitute a substantial and material breach of this contract.

ARTICLE 25 – POST-BID SUBMITTALS

25.1 *Disadvantaged Business Enterprises Participation*

A. Non-Applicable.

ARTICLE 26 – RETAINAGE

26.01 Provisions concerning Contractor's rights to deposit securities in lieu of retainage are set forth in the Agreement.

ARTICLE 27 – CONTRACTS TO BE ASSIGNED

27.01 Non-Applicable

ARTICLE 28 – PARTNERING

28.01 Non-Applicable.

ARTICLE 29 – OTHER CONTRACTS

29.1 The attention of bidders is directed to the fact that the work to be done under this contract is only part of a program of improvements, that contracts have been let for additional facilities, and that the successful operation of the improvements is dependent upon the completion of the work under this contract and of the work to be done by others.

29.2 It is essential that all parties interested in the project cooperate to the end that the entire project will be brought to a successful conclusion as rapidly as possible, but the Owner cannot guarantee that no interference or delay will be caused thereby. Interference and delay resulting from such cooperation shall not be the basis of claims against the Owner.

ARTICLE 30 – FEDERALLY ASSISTED CONTRACT

30.01 This Contract is Federally assisted. The Contractor must comply with the Davis-Bacon Act, the Anti-Kickback Act, the Contract Work Hours Standards Act, Title VI of the Civil Rights Act of 1964, and Executive Orders 11246 and 11375.

ARTICLE 31 – FEDERAL WAGE RATES

31.1 *Davis – Bacon Act*

A. For all prime construction contracts in excess of $2,000, the contractor must comply with all state and federal requirements as governed by the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146--3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week.

ARTICLE 32 – OTHER PROVISIONS

32.1 *Copeland Anti-Kickback Clause*

A. For all prime construction contracts in excess of $2,000, the contractor must comply with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subcontractor must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

32.2 *Suspension and Debarment*

A. This contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such the contractor is required to verify that none of the contractor, its principals (defined at 2 C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. §180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935). The contractor must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by (insert name of subgrantee). If it is later determined that the contractor did not comply

with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to (name of state agency serving as grantee and name of subgrantee), the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

B. A prospective contractor that is listed on the government-wide Excluded Parties List System in the System for Award Management (www.SAM.gov) as suspended or debarred, **CANNOT** be awarded a contract funded with Federal assistance.

32.3 *Anti-Lobbying*

A. Contractors who apply or bid for an award of $100,000 or more shall file the required certification must comply with the Byrd Anti-Lobbying Amendment, 31 U.S.C. § 1352 as amended. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

32.4 *Clean Air Act and Federal Water Pollution Control Act*

A. For all contracts exceeding $150,000, the contractor must comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387), and will report violations to the Regional Office of the Environmental Protection Agency (EPA).

32.5 *Non-Discrimination*

A. The contractor shall comply with the Elliott Larsen Civil Rights Act, 1976 PA 453, as amended, MCL 37.2101 et seq., the Persons with Disabilities Civil Rights Act, 1976 PA 220, as amended, MCL 37.1101 et seq., and all other federal, state, and local fair employment practices and equal opportunity laws and covenants that it shall not discriminate against any employee or applicant for employment, to be employed in the performance of this Agreement, with respect to his or her hire, tenure, terms, conditions, or privileges of employment, or any matter directly or indirectly related to employment, because of his or her race, religion, color, national origin, age, sex, height, weight, marital status, or physical or mental disability that is unrelated to the individual's ability to perform the duties of a particular job or position. The contractor agrees to include in every subcontract entered into for the performance of this Agreement this covenant not to

discriminate in employment. A breach of this covenant is a material breach of this Agreement.

32.6 *American Iron and Steel (AIS) Requirements*

A. The Contractor acknowledges to and for the benefit of the City of Flint ("Purchaser"), that all iron and steel products used in the project be produced in the United States ("AIS Requirements") including iron and steel provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser that (a) the Contractor has reviewed and understands the AIS Requirements, (b) all iron and steel used in the project will be and/or have been produced in the United States in a manner that complies with the AIS Requirements, unless a waiver of the requirements is approved by the Purchaser, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the AIS requirements, as may be requested by the Purchaser. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser to recover as damages against the Contractor any loss, expense or cost (including without limitation attorney's fees) incurred by the Purchaser resulting from any such failure.

END OF SECTION

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SECTION 00 41 13

BID FORM

ARTICLE 1 – BID RECIPIENT

1.1 This Bid is submitted to:

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

Attn: Joyce A. McClane
Purchasing Manager

(Hereinafter called Owner)

1.2 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 120 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder shall sign and deliver the required number of counterparts of the Agreement with the bonds and other documents required by the Bidding Documents within twenty (20) days after the issuance date of the Notice of Award.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.1 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in SC-4.02 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable "technical data."

E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

J. In connection with the performance of Work under this Contract, Bidder agrees not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition or developmental disability, or national origin.

K. The submission of this Bid constitutes and incontrovertible representation by the Bidder that the Bidder has complied with every requirement of the Bidding Documents, and

that without exception, the Bid prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.1 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.1 Bidder will complete the Work in accordance with the Contract Documents for the prices identified below.

A. Unit Prices shall be computed in accordance with Paragraph 11.03.B of the General Conditions.

B. The Owner reserves the right to award additional assignments once a Contract's original scope of work is completed and accepted by the Owner.

C. The Contractor shall not be entitled to renegotiate any unit pricing based upon the quantity of any work.

D. Bidder acknowledges that quantities of work are not guaranteed. Final payment for all unit price Bid items will be based on actual quantities of work completed as described in the Contract Documents.

E. The City of Flint reserves the right to reject any or all Bids, or to accept or reject any Bid in part, and to waive any minor informality or irregularity in the Bid received if it is determined by the City of Flint, or their designee, that the best interest of the City will be served by doing so. No Bid will be considered from any person, firm or corporation in arrears or in default to the City on any contract, debt, taxes or other obligation, or if the Bidder is debarred by the City of Flint from consideration for a Contract award.

The undersigned bidder will complete the Work in accordance with the Contract Documents for the following pay items:

Item #	Description	Quantity	Units	Unit Price	Amount
Item #1	Remove and Replace Roof	1	LS	_____	_____
Item #2	Demo for Access Hatches and Two New Hatches	2	EA	_____	_____
Item #3	Demo of Wall Section Influent Channel	1	LS	_____	_____
Item #4	48" Influent Manifold	1	LS	_____	_____
Item #5	48" Butterfly Valve & Operator	1	EA	_____	_____
Item #6	30" Butterfly Valve	6	EA	_____	_____
Item #7	10" Check Valve	3	EA	_____	_____
Item #8	Three Horizontal Split Case Pumps With Motor and Shafts	3	EA	_____	_____
Item #9	Intermediate Bearing Supports	3	EA	_____	_____
Item #10	Grating on Existing Intermediate Bearing Supports	1	EA	_____	_____
Item #11	Reagent less Cl_2 Analyzer	1	EA	_____	_____
Item #12	Pressure Transducer	1	EA	_____	_____
Item #13	Cl_2 Feed Systems Complete With Injection Piping	2	EA	_____	_____
Item #14	Handrailing	1	LS	_____	_____
Item #15	Ships Ladder	4	EA	_____	_____

Item #16	Masonry Repair	1	LS	_____	_____
Item #17	Sidewalk Replacement	1	LS	_____	_____
Item #18	Lighting	1	LS	_____	_____
Item #19	Transformer	1	EA	_____	_____
Item #20	200 Hp 480V VFDs	3	EA	_____	_____
Item #21	Electrical Equipment Demo	1	LS	_____	_____
Item #22	New Pass Door	1	EA	_____	_____
Item #23	Rest Room Rehabilitation	1	LS	_____	_____
Item #24	Painting	1	LS	_____	_____
Item #25	Piping, Fittings,	1	LS	_____	_____
Item #26	PLC Programming Allowance	1	LS	$ 30,000.00	$ 30,000.00
Item #27	Remove & Plug Sluice Gate	2	EA	_____	_____
Item #28	Check Wiring for Existing VFD For Pump #1 and Complete Wiring	1	LS	_____	_____
Item #29	Mobilization	1	LS	_____	_____
Item #30	Start Up	2	EA	_____	_____
Item #31	Arc Flash Analysis	1	LS	_____	_____
Item #32	Short Circuit Calculation	1	LS	_____	_____
Item #33	Contingency Allowance	1	LS	$ 120,000.00	$ 120,000.00
Item #34	Building Permit Allowance	1	LS	$ 50,000.00	$ 50,000.00
Item #35	Secondary Water Supply Interconnection	1	LS	_____	_____

Pay items have been computed in accordance with Article 11 of the General Conditions. Work not specifically listed as a Pay Item is included in the Pay Items listed and will not be paid for separately.

In accordance with the above understanding, the undersigned proposes to perform the Work, furnish all labor, materials and equipment to complete the Work in its entirety in the manner and under the conditions required for the Contract Price of

_____$_____.
Total Bid Amount in Words

G. This Contract will be awarded to the lowest responsive, responsible Bidder. The Bidder(s) to whom an award is made will be notified at the earliest possible date. Tentative acceptance of the Bid, intent to recommend award of a contract, and actual award of the Contract will be provided by written notice sent to the Bidder at the address designated in the bid. After a final award of the Agreement by the City of Flint, the Bidder must execute and perform said Agreement. If, for by reasons of refusal by the Bidder, a contract is not executed with the selected Bidder after notice of recommendation for award, then the City may recommend the next lowest responsive and responsible Bidder.

ARTICLE 6 – TIME OF COMPLETION

6.1 Bidder agrees that the Work is anticipated to be substantially complete on or before January 30, 2021 and will be completed and ready for final payment in accordance with Paragraph 14.7 of the General Conditions on or before May 30, 2021.

6.2 Bidder accepts the provisions of the Agreement as to liquidated damages should final completion exceed anticipated completion date based upon mutual acceptance of the contract parties.

6.3 **All Work shall be done under a one (1) year warranty.**

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.1 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security in the form of a Bid Bond. Refer to Section 00 43 13;

B. Non-collusion Affidavit of Prime Bidder included as Exhibit B.

C. Bid Certification Form included as Exhibit C.

D. List of Proposed Subcontractors. Use the form included as Exhibit D.

E. List of Proposed Suppliers. Use the form included as Exhibit E.

F. List of Project References. Use the form included as Exhibit F.

G. Evidence of authority to do business in the state of Michigan; or a written covenant to obtain such license within the time for acceptance of Bids;

H. Contractor's License No: [_____] (if applicable) Evidence of Bidder's ability to obtain a

State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;

I. Required Bidder Qualification Statement with Supporting Data; and

J. Ownership statement. Use the form included as Exhibit G.

K. Supplemental information as defined in Article 3 of the Instructions to Bidders.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.1 This Bid is submitted by:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____

By: _____
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____
Type (General Business, Professional, Service, Limited Liability): _____

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

Date of Qualification to do business in Michigan is _____/____/____.

A Joint Venture

Name of Joint Venture: _____

First Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of first joint venture partner - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Bidder's Business Address _____

_____

Phone No. _____ Fax No. _____

E-mail _____ _____

SUBMITTED on_____, 20____.

State Contractor License No._____.

Sworn and subscribed to before me this

_____ day of_____, 20____.

_____
Notary or other officer authorized to administer oaths

My commission expires:_____, 20____.

(Bidders shall not add any conditions or qualifying statements to this Bid as otherwise the Bid may be declared irregular as being not responsive to the advertisement. BIDDERS SHALL USE THIS BID FORM IN SUBMITTING THEIR BIDS.)

Bidder acknowledges that the above representations are material and important and will be relied on by the Owner in awarding the Contract(s) for which this Bid is submitted. The Bidder understands that misstatement in this Bid is and shall be treated as fraudulent concealment from the Owner of the true facts relating to the submission of the Bid for this Contract.

Bidder, being duly sworn, deposes and states that he is the person making the above Bid or is authorized to make this Bid on behalf of said partnership, joint venture or corporation; and that said Bid is genuine and not sham or collusive, and is not made in the interest of or on behalf of any person, partnership, joint venture, or corporation not therein named, and that he has not directly or indirectly induced or solicited any bidder to put in a sham bid; that he has not directly or indirectly induced or solicited any other person, partnership, joint venture, or corporation to refrain from bidding, and that he has not in any manner sought by collusion to secure himself or to said partnership, joint venture, or corporation an advantage over other bidders.

EXHIBIT A

CHECKLIST OF ITEMS REQUIRED FOR SUBMISSION OF BID

BIDDERS MUST COMPLETE THIS SHEET AND SUBMIT WITH THEIR BID, ALONG WITH THE FOLLOWING ITEMS

____ Checklist form – Exhibit A
____ Non-Collusion Affidavit – Exhibit B
____ Bid Certification - Exhibit C
____ Capacity information
- Bidder has to provide information on their capacity to perform the work outlined in the bid documents.
- Provide a historical summary of work that demonstrates the required experience, both in time and quantity of work completed.

____ Experience and qualifications
- Identify all subcontractors (if applicable) and provide same information as proposed bidder. – Exhibit D
- Identify all equipment and suppliers (if applicable) intended to be utilized for this contract. – Exhibit E

____ References
- Supply at least five (5) references from municipalities (city, county, township, etc.) or communities (or developments) demonstrating experience working on projects that are similar in size and scope to this project. Please include customer's name, dates of contracts, summary of services provided, reference contact name, phone number, and address. – Exhibit F

____ Other
- Ownership Statement – Exhibit G
- Identify the name of the landfill or approved disposal site in which excavation spoils, debris, and waste will be disposed for the period of this contract. The City may request financial information of said landfill or disposal site at a later date.
- Describe how your company meets or exceeds the minimum experience qualification of the services requested.
- Any information that the vendor would like to submit with their proposal.

_____ Supplemental information as defined in Article 3 of the Instructions to Bidders.
_____ Bid Bond – Section 00 43 13
_____ (Appendix E) – (DBE) Utilization Good Faiths Worksheet, Debarment/Suspension Certification

PLEASE NOTE: FAILURE TO SUBMIT THE ABOVE ITEMS WILL RESULT IN A REJECTION OF YOUR BID.

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EXHIBIT B

NON-COLLUSION AFFIDAVIT

State of _____:

s.s.

County of _____:

I state that I am _____ of _____
(Title) (Name of Firm)

and that I am authorized to make this affidavit on behalf of my Firm, its Owner, Directors and Officers. I am the person responsible in my firm for the price(s) and the amount of the bid.

I state that:

1. The price(s) and the amounts of this bid have been arrived at independently and without consultation, communication or agreement with any other contractor, bidder or potential bidder.
2. Neither the price(s) nor the amount of the bid, and neither the approximate price(s) nor the approximate amount of the bid, have been disclosed to any other firm or person who is a bidder or potential bidder, and they will not be disclosed before the bid opening.
3. No attempt has been made or will be made to induce any firm or person to refrain from bidding on this contract, or to submit a bid higher than this bid, or to submit any intentionally high or noncompetitive or other form of complementary bid.
4. The bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a discussion with, or inducement from, any firm or person to submit a complementary or noncompetitive bid.
5. _____, its affiliates, subsidiaries, officers, directors and employees are not currently under investigation by any governmental agency and have not in the last four years been convicted or found liable for any act prohibited by State or Federal law in any jurisdiction, involving conspiracy or collusion with respect to bidding on any public contract, except as follows:

_____

_____

_____

_____

_____

I state that_____understands and
(Name of Firm)

Acknowledges that the above representations are material and important and will be relied on by the City of Flint, Department of Purchase and Supplies in awarding the contract(s) for which this bid is submitted. I understand and my firm understands that misstatement in this affidavit is and shall be treated as fraudulent concealment from the City of Flint, Department of Purchase and Supplies of the true facts relating to the submission of bids for this contract.

_____
(Signature)

_____
(Printed Name)

_____
(Position / Job Title)

EXHIBIT C

BID CERTIFICATION FORM

THIS PAGE MUST BE COMPLETED AND INCLUDED WITH THE BID

The undersigned hereby certifies, on behalf of the respondent named in this Certification (the "Respondent"), that the information provided in this offer submitted to the City of Flint, Department of Purchase and Supplies is accurate and complete, and that I am duly authorized to submit same. I hereby certify that the Respondent has reviewed all documents and requirements included in this offer and accept its terms and conditions.

Company (Respondent): _____

Address: _____

_____

City, State & Zip Code: _____

Phone / Fax Number: _____

Email: _____

Authorized Representative: _____
(Printed)

_____
(Signature)

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EXHIBIT D

LIST OF SUBCONTRACTORS

Herewith is the list of Subcontractors referenced in the Bid submitted by:

_____

(Bidder)

City of Flint, Department of Purchases and Supplies
(Owner)

dated _____

The following work will be performed (or provided) by the following Subcontractors, and coordinated by us:

SECTION OF WORK	SUBCONTRACTOR'S NAME

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EXHIBIT E

LIST OF SUPPLIERS

Herewith is the list of Suppliers referenced in the Bid submitted by:

_____

(Bidder)

City of Flint, Department of Purchases and Supplies
(Owner)

dated _____

The following work will be performed (or provided) by the following Suppliers, and coordinated by us:

SECTION OF WORK	EQUIPMENT NAME	SUPPLIER'S NAME

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EXHIBIT F

PROJECT REFERENCES

Herewith is the list of Project References referenced in the Bid submitted by:

_____

(Bidder)

City of Flint, Department of Purchases and Supplies
(Owner)

dated _____

The following work will be performed (or provided) by the following Project References, and coordinated by us:

PROJECT	
Owner's Name	
Owner's Contact Person	
Owner's Contact Phone Number	
Owner's Contact Address	
Owner's Contact Email Address	
Description of Work (include value of contract and date of work):	
Owner's Name	
Owner's Contact Person	
Owner's Contact Phone Number	
Owner's Contact Address	
Owner's Contact Email Address	
Description of Work (include value of contract and date of work):	

Owner's Name	
Owner's Contact Person	
Owner's Contact Phone Number	
Owner's Contact Address	
Owner's Contact Email Address	
Description of Work (include value of contract and date of work):	

Owner's Name	
Owner's Contact Person	
Owner's Contact Phone Number	
Owner's Contact Address	
Owner's Contact Email Address	
Description of Work (include value of contract and date of work):	

Owner's Name	
Owner's Contact Person	
Owner's Contact Phone Number	
Owner's Contact Address	
Owner's Contact Email Address	
Description of Work (include value of contract and date of work):	

EXHIBIT G

OWNERSHIP STATEMENT

OWNER - City of Flint, Department of Purchase and Supplies

ENGINEER - City of Flint or their designee

PROJECT - ***Dort Pump Station Rehabilitation***

ARTICLE 1

1.1 If the Bidder is a corporation, partnership, limited partnership, limited liability corporation, limited liability partnership or a subchapter S corporation, the Bidder, in compliance with P.L. 1977, Chapter 33, shall submit, with the Bid, the following statement setting forth the names and addresses of all stockholders or individual partners who own ten percent (10%) or more of its stock or interest. If one or more such stockholder or partner is itself a corporation, partnership, limited partnership, limited liability corporation, limited liability partnership or a subchapter S corporation, the stockholders holding ten percent (10%) or more of that corporation's stock, or the individual partners owning ten percent (10%) or greater interest in that partnership, as the case may be, shall also be listed.

IF NONE, SO STATE

INDIVIDUAL	ADDRESS

NOTE: ADDITIONAL SHEETS CONSISTING OF PAGES ARE ATTACHED.

END OF SECTION

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SECTION 00 43 13

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:
City of Flint, Department of Purchases and Supplies
1101 S. Saginaw St., Room 203
Flint, MI 48502

BID
Bid Due Date: Thursday December 3, 2020 at 3:00 PM EST
Description: *Dort Pump Station Rehabilitation*: City of Flint

BOND
Bond Number:
Date *(Not earlier than Bid due date)*:

Penal sum - 5% of base bid (Words) - 5% of base bid (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
	_____(Seal)_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	
Print Name	Print Name
_____	
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	
Title	Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 52 13

AGREEMENT

THIS AGREEMENT is by and between:

The City of Flint Department of Purchases and Supplies ("Owner")

and

_____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

11.1 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described in Section 01 10 00 – Summary of Work.

ARTICLE 2 – THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Rehabilitation of the Dort Pump Station at the Flint Water Treatment Plant. The project will include structural concrete repair

3.01 The Project has been developed by the City of Flint or it's designee, which is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.1 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.2 *Dates for Substantial Completion and Final Payment*

A. The Work will be substantially completed on or before July1, 2021 for the Phase 1 and November 30, 2021 for Phase 2, completed and ready for final payment in accordance with Paragraph 14.7 of the General Conditions on or before December 31, 2021.

4.3 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $1,000 for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is considered by the Engineer to be substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $500 for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

B. Owner reserves the right to withhold liquidated damages from Contractor's final payment, including retainage, in the event the Contractor refuses to pay said liquidated damages. Contractor is responsible for the payment of all liquidated damages in the event the amount of liquidated damages exceeds the value of the work to be paid, including retainage.

4.4 Permitting Contractor or Surety to continue and finish the Work or any part of the Work after the times specified for completion, or after the date to which the times for completion may have been extended, shall in no way operate as a waiver on the part of Owner of its rights under the Contract.

ARTICLE 5 – CONTRACT PRICE

5.1 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A below:

A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.1 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

B. Contractor will be required to submit certified payroll reports with each payment application so that the Owner can confirm compliance with mandated wage rates.

6.2 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 15th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

a. 10 percent of Work completed, with the balance being retainage.

b. Upon written approval of the Engineer and Owner, retainage will be reduced to 5 percent of the work completed, if the Work has been 50 percent completed and if the character and progress of the Work have been satisfactory to Owner and Engineer. The Owner reserves the right to maintain retainage at 10% of work completed over the entire duration of the contract.

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts as Engineer shall determine, in accordance with Paragraph 14.02.B.5 of the General Conditions, to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.3 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – INTEREST

7.01 Non applicable.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

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

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.2 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.6 of the Supplementary Conditions as containing reliable "technical data."

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site- related reports and drawings identified in the Contract Documents, if any, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 8.1.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

J. In connection with the performance of Work under this Contract, Contractor agrees not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition or developmental disability, or national origin. This provision shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training including apprenticeship. Contractor further agrees to take affirmative action to ensure

equal employment opportunities for persons with disabilities. Contractor agrees to post in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of the nondiscrimination clause. Form of notice is included in the Project Forms.

ARTICLE 9 – CONTRACT DOCUMENTS

9.1 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages 00 52 13-1 to 00 52 13-8, inclusive).
2. Performance bond (pages 00 61 13-1 to 00 61 13-4, inclusive).
3. Payment bond (pages 00 61 16-1 to 00 61 16-4, inclusive).
4. General Conditions (pages 00 72 00-1 to 00 72 00-62, inclusive).
5. Supplementary Conditions (pages 00 73 02-1 to 00 73 02-20, inclusive).
6. Specifications as listed in the Table of Contents of the Project Manual.
7. Addenda (numbers to , inclusive).
8. Exhibits to this Agreement (enumerated as follows):
    a. Contractor's Bid (pages 00 41 13-1 to 00 41 13-22, inclusive).
9. Davis-Bacon Prevailing Wage Rates, as provided by Owner.
10. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.4 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.1 *Terms*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.2 *Assignment of Contract*

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys 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.

10.3 *Successors and Assigns*

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

10.4 *Severability*

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

10.5 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.5:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

OWNER:

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest

: _____

Title:_____

Address for giving notices:

_____

_____

_____

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

CONTRACTOR

_____

By: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Title: _____

Address for giving notices:

_____

_____

_____

License No.: _____

(Where applicable)

Agent for service of process:

_____

Countersigned By:

_____

Comptroller
(Or other designated official)

END OF SECTION

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

SECTION 00 61 13

PERFORMANCE BOND (EJCDC C-610)

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*: City of Flint, Department of Purchases and Supplies
1101 S. Saginaw Street, Room 203
Flint, MI 48502

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years

after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

SECTION 00 61 16

PAYMENT BOND (EJCDC C-615)

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*: City of Flint, Department of Purchases and Supplies
1101 S. Saginaw Street, Room 203
Flint, MI 48502

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment plumb, st for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

      5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

   7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

   7.2 Pay or arrange for payment of any undisputed amounts.

   7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by

anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

ACEC
American Council of Engineering Companies

The Associated General Contractors of America
Skill Responsibility Integrity

ASCE American Society of Civil Engineers

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ASSOCIATED GENERAL CONTRACTORS OF AMERICA

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Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.1 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the 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.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *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.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *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.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *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.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *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 for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered 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 Times.

1.2 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. 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.

2. 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.

3. 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.

4. 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.

F. Unless stated otherwise in the Contract Documents, words or phrases that 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

2.1 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.2 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.3 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth 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 Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.4 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.5 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.6 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.7 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on

Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.1 *Intent*

A. The Contract Documents are complementary; what is required by one 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. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.2 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

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

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

3.3 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work*: 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 shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected hereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: 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 (a) any applicable Law or Regulation , (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, 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:

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

   b. 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).

3.4 *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 by either a Change Order or a Work Change Directive.

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

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.5 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.6 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. 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; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.1 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

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

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

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

4.3 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to relyas provided in Paragraph 4.02 is materially inaccurate; or

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

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

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

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

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 Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

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

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

4.4 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for 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 such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the

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

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.5 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.6 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

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

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

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

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

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly 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 condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such 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 the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and 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 relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and 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 relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.1 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, 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 until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the 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 Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared 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 Paragraph 5.1.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.1.B and 5.2.

5.2 *Licensed Sureties and Insurers*

A. All 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. Such surety and insurance companies shall also

meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.4 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

a. Such insurance shall remain in effect for two years after final payment.

b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.5 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.6 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.7 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses 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.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.8 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 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 and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.9 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's

interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.1 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, 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 not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.2 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.3 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide 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 performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications 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 source, kind, and quality of materials and equipment.

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

6.4 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.5 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

a. 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 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services; and

4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.5.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.5.A and 6.5.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.6 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.6.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be

required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

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 a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,

Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss 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.

6.7 *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 the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and 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 relating to 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 specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and 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 relating to 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.

6.8 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, 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 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. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.9 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and 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 relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas 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.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and 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 relating to any claim or action, legal or equitable, brought

by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* 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.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. 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 Site or who may be affected by the Work;

2. all the Work and materials and 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, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property 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 and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. 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.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for 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 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate 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.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material 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 Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor 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 or are required as a result thereof. 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.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

a. Submit number of copies specified in the General Requirements.

b. 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 services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample 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 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

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

a. 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;

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

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

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

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

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

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

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

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

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

6.18 *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 permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. 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 by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

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

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

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

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and 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 relating to the performance of the Work, provided that 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 but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A 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 or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *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 and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment 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 properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings 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, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and 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 and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.1 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.2 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.3 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.1 *Communications to Contractor*

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

8.2 *Replacement of Engineer*

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

8.3 *Furnish Data*

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

8.4 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.5 *Lands and Easements; Reports and Tests*

A. Owner's duties with 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 explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.6 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.7 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.8 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.9 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.1 *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 are set forth in the Contract Documents.

9.2 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or

continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.3 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.4 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which 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. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved 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 Claim may be made therefor as provided in Paragraph 10.05.

9.5 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer 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.

9.6 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.7 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.5.

9.8 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes 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 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.5.

D. When functioning as interpreter and judge under this Paragraph 9.8, 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.

9.9 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not

exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

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 performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

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

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.7.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.9 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.1 *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 by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.5.

10.2 *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 as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.4.D.

10.3 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.1.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. 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; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.5; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.4 *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.

10.5 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.9, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data

shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.1.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.2.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.5.C or denial pursuant to Paragraphs 10.5.C.3 or 10.5.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.5.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.1 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.1.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs 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 11.1.B, 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, 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. Cost 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 11.1.

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. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. 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.

    c. 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.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. 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.

f. 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 5.06.D), 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 Contractor's fee.

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

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

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

B. *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 11.1.A.1 or specifically covered by Paragraph 11.1.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

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

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

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not

limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.1.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an 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 12.1.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.1.A and 11.1.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.2 *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:*

1. Contractor agrees that:

a. 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

b. Contractor's costs for unloading and handling on 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:*

1. 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.

11.3 *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 Agreement.

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. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.7.

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. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.5 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

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

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.1 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.5.

B. The value of any Work covered by a Change Order or of any Claim for 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, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.3); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.1.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.1.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.1) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.1.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

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

   a. for costs incurred under Paragraphs 11.1.A.1 and 11.1.A.2, the Contractor's fee shall be 15 percent;

   b. for costs incurred under Paragraph 11.1.A.3, the Contractor's fee shall be five percent;

   c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.1.C.2.a and 12.1.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.1.A.1 and 11.1.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

   d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.1.A.4, 11.1.A.5, and 11.1.B;

   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 five 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 12.1.C.2.a through 12.1.C.2.e, inclusive.

12.2 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.5.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.3 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.2.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or

neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, 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 an equitable adjustment in the Contract Price or the Contract Times, or both. 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.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is 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 described in this Paragraph 12.3.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or 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) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.1 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.2 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.3 *Tests and Inspections*

A. Contractor shall give Engineer timely notice 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. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.3.C and 13.3.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.4.B shall be paid as provided in Paragraph 13.4.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.3.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.4 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

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.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and 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 relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.5.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.5.

13.5 *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 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, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.6 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and 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 relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.6 or Paragraph 13.7, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.7 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed 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, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

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

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

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and 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 relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.7, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.7 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.7 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.8 *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, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and 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) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.5. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.9 *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 13.6.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.9, Owner shall proceed expeditiously. In connection with such corrective or 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 and Engineer's consultants access to the Site to enable Owner to exercise therights and remedies under this Paragraph.

C. All claims, costs, losses, and 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) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.9 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.5. Such claims, costs, losses and damages will include 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 Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.9.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.1 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.7.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.2 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. 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 a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or 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.

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

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.7, and any other qualifications stated in the recommendation); and

   c. 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.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. 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.

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

   a. to supervise, direct, or control the Work, or

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

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

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

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

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.2.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

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

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.9; or

   d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.2.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.2.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

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

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. 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;

   c. there are other items entitling Owner to a set-off against the amount recommended; or

   d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.2.B.5.a through 14.2.B.5.c or Paragraph 15.2.A.

2. 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 remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.2.C.1 and subject to interest as provided in the Agreement.

14.3 *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 no later than the time of payment free and clear of all Liens.

14.4 *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 (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

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. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before

final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. 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 tentative list.

14.5 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.4.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.4 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.6 *Final Inspection*

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

14.7 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.4.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

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

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.7.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. 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

as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.9. Otherwise, Engineer will return the Application for Payment 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 for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.8 *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 (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, 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 5.1, 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.

14.9 *Waiver of Claims*

A. The making and acceptance of final payment will 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 14.6, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.1 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.5.

15.2 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure 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 2.7 as adjusted from time to time pursuant to Paragraph 6.4);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.2.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and 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);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.2.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and 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) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer,

incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.2.B and 15.2.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.1.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.2.B and 15.2.C.

15.3 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. 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, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and 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) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to 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.

15.4 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days

to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.3.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.4 are not intended to preclude Contractor from making a Claim under Paragraph 10.5 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.1 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.5.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.5.C or a denial pursuant to Paragraphs 10.5.C.3 or 10.5.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.1 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.2 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will 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 will be omitted from the computation.

17.3 *Cumulative Remedies*

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 are not to 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 Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will 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.

17.4 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.5 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.6 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 02

SUPPLEMENTARY CONDITIONS

ARTICLE 1. DEFINITIONS

SC-1.1

Defined Terms:

Delete Subparagraph 1.1.A.8 in its entirety and insert the following in its place:

8. *Bidding Requirements* - The Official Notice, Advertisement or Invitation to Bid; Instructions to Bidders; Bid security of acceptable form, if any; and the Bid Form with any supplements.

SC-1.1

Defined Terms:

Insert the following language before the word “Agreement” in the first sentence of the definition 1.1A.12 entitled "Contract Documents" in the General Conditions:

Invitation to Bid, Instructions to Bidders, and

SC-1.01

Defined Terms:

Add the following new paragraph immediately after 1.1.A.20:

52. *Final Completion* – All Work completed, including punch list work, per the Specifications; and as a prerequisite for the Contractor’s application for final payment.

SC-1.01

Defined Terms:

Add the following new paragraph immediately after paragraph 1.01.A.31:

32. *Products* - Means materials and equipment that Contractor furnishes and provides, other than labor and services.

SC-1.01

Defined Terms:

Delete Subparagraph 1.01.A.34 in its entirety and insert the following in its place:

34. *Project Manual* - The Project Manual is the volume assembled for the Work which includes the Bid Documents, Contract Documents, and Specifications.

ARTICLE 2. PRELIMINARY MATTERS

SC-2.1

Copies of Documents:

Delete paragraph 2.1B of the General Conditions in its entirety and insert the following in its place:

B. Before any work at the site is started, Contractor shall deliver to Owner, with a copy to Engineer, certificates of insurance (and other evidence of insurance requested by Owner) which Contractor is required to purchase and maintain in accordance with the requirements of Article 5.

1. Contractor shall include and identify on the certificate of insurance, indemnification as required by Article 6.20.

2. Engineer shall furnish to the Contractor, the form for Certificate of Insurance to be completed.

SC-2.2

Copies of Documents:

Add the following to the end of the first sentence in Paragraph 2.2.A.:

and one set in electronic format.

SC-2.3

Commencement of Contract Times; Notice to Proceed:

Delete the last sentence of Paragraph 2.3.A. in its entirety

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SC-2.5

Before Starting Construction:

Amend the first sentence of Paragraph 2.05.A.3. by inserting the words “except for Unit Price Work” at the beginning of the sentence.

ARTICLE 3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

SC-3.1

Intent:

Add a new paragraph immediately after paragraph 3.01A of the General Conditions which is to read as follows:

1. Each and every provision of law and clause required by law to be inserted in the Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though they were included herein. If through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

2. Sections of Division 1 - General Requirements govern the execution of the work of all sections of the specifications.

ARTICLE 4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

SC-4.2

Subsurface and Physical Conditions:

Delete paragraph 4.2A of the General Conditions in its entirety and insert the following in its place:

A. Reports and Drawings: Structural Condition Assessment dated January 13, 2007 and original construction drawings. These reports are not part of the contract documents.

SC-4.5

Reference Points:

Delete paragraph 4.5A in entirety and replace with the following:

A. No engineering surveys or reference points are provided for this contract.

SC-4.6

Hazardous Environmental Conditions at Site:

Delete Paragraphs 4.6.A. and 4.6.B. in their entirety and insert the following in their place:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

B. Not used.

ARTICLE 5. BONDS AND INSURANCE

SC-5.1

Performance, Payment and Other Bonds:

Add the following language at the end of Paragraph 5.1.C:

In addition, no further progress payments under the Agreement will be made by Owner until Contractor complies with the provisions of this paragraph.

SC-5.2

Licensed Sureties and Insurers:

Add the following language at the end of Paragraph 5.2.A.:

Insurance companies shall have a VI or better rating by Best's Insurance Guide Rating.

SC-5.3

Add the paragraph F. immediately after paragraph 5.3E of the General Conditions to read as follows:

F. Contractor shall provide to the Owner evidence of its insurance coverages and endorsements for review and determination by Owner of the adequacy of all coverages, deductibles, and/or self-insured retentions when Contractor delivers the executed counterparts of the Agreement to Owner. Evidence of coverage may be provided on the ACORD certificate of insurance form and shall include the following endorsements attached to the applicable certificate of insurance:

1. Additional Insured (CG 20 10 07 04 and CG 20 37 07 04 forms)

2. Waiver of Transfer of Rights of Recovery (CG 24 04 05 09 form)

3. Primary Non-Contributory (GLE0007 01-96 form)

4. Designated Construction Project General Aggregate Limit (CG 25 03 05 09)

SC-5.4

Contractor's Insurance:

Amend the subparagraph 5.4.B.6.a by deleting the words "two years" and inserting the words "three years".

SC-5.04

Contractor's Insurance:

Add the following new paragraph immediately after Paragraph 5.4.B.:

C. The limits of liability for the insurance required by Paragraph 5.4 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Worker's Compensation, and related coverage under Paragraphs 5.4.A.1 and 5.04.A.2 of the General Conditions. Statutory coverage or proof acceptable to the City of approval as a self-insurer by the State of Michigan.

a.	Workers Compensation:	Statutory
b.	Applicable Federal:	Statutory
c.	Employer's Liability:	$100,000 (each accident) $100,000 disease (each employee)
d.	Disease:	$500,000 (policy limit)

2. Contractor's General Liability under Paragraphs 5.04.A.3 through 5.04.A.6 of the General Conditions which shall include completed operations and product liability coverage's and eliminate the exclusion with respect to property under the care, custody, and control of Contractor or provide equivalent coverage under Builders Risk:

a.	General Aggregate:	$1,000,000 (each occurrence) $2,000,000 (general aggregate)
b.	Operations Aggregate:	$2,000,000
c.	Personal and Advertising Injury:	$1,000,000
d.	Bodily Injury and Property Damage:	$500,000 (each occurrence)
e.	Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.	
f.	Excess or Umbrella Liability:	$1,000,000 (general aggregate) $1,000,000 (each occurrence)

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions. Michigan "no-fault" coverage, and residual automobile liability, comprehensive form, covering,

owned, hired, and non-owned automobiles.

a. Bodily Injury: $500,000 (each person)
$1,000,000 (each accident)

b. Property Damage: $500,000 (each accident)

4. The Contractual Liability coverage required by Paragraph 5.04.B.3 of the General Conditions shall provide coverage for not less than the following amounts:

a. Bodily Injury: $1,000,000 (each accident)
$2,000,000 (annual aggregate)

b. Property Damage: $500,000 (each accident)
$1,000,000 (annual aggregate)

5. In addition to those identified and entities specified in the General Conditions include as additional insured the following:

a. City of Flint, Michigan

b. City of Flint, Department of Purchases and Supplies

c. Subcontractors

SC-5.6

Property Insurance:

Delete Paragraph 5.6.A in its entirety and insert the following in its place:

A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any deductible or self-insured retention. The insurance shall:

1. Include the interests of Owner, Contractor, Subcontractors, Engineer, individual property owners, and any other individuals or entities identified herein, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or loss payee;

(NTS: List below those individual or entities to be identified in the paragraph above. See NTS above for discussion of additional insureds.)

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary

Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner

6. include testing and startup;

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued;

8. comply with the requirements of Paragraph 5.6.C. of the General Conditions.

ARTICLE 6. CONTRACTOR'S RESPONSIBILITIES

SC-6.5

Substitutes and "Or Equals":

Add the following language at the end of Paragraph 6.5.D.:

> …in the form of a Special Performance Guarantee and Surety Bond included in the Project Forms of the Project Manual.

SC-6.5

Substitutes and "Or Equals":

Delete Paragraph 6.5.E. in its entirety.

SC-6.5

Substitutes and "Or Equals":

Add the following new paragraphs immediately after Paragraph 6.5.F.:

1. When a substitute item of material or equipment is proposed by Contractor and accepted by Engineer, and the substitution will require a change in any of the Contract Documents to adapt the design to the proposed substitute, Contractor shall notify Engineer of the changes and be responsible for the costs involved to revise the design and to make modifications or changes to the construction, including the costs associated with the Work of other contractors due to such changes in design or space requirements.

a. Redesign and drawing revisions will be prepared by Engineer and Contractor shall reimburse Owner for charges of Engineer for redesign and drawing preparation.

b. Reimbursement of Engineer shall be based on Engineer's direct labor costs, indirect labor costs, profit on the total labor, and any direct non-labor expenses such as travel or per diem.

SC-6.06

Concerning Subcontractor's, Suppliers, and Others:

Renumber subparagraph 6.6F to 6.6G and subparagraph 6.6G to 6.6H and add new subparagraph as follows:

F. Owner or Engineer may furnish to any such Subcontractor, Supplier, or other person or organization, to the extent practicable, information about amounts paid to Contractor in accordance with Contractor's Applications for Payment on account of the particular Subcontractor's, Suppliers, other person's, or other organization's Work.

SC-6.10

Taxes:

Add the following new paragraphs immediately after Paragraph 6.10.A.:

1. Contractor shall investigate the statutory requirements for payment of sales taxes and if required shall include the tax in the Contract price.

2. If investigation indicates tax exempt status, Contractor(s) shall forward this information to its Suppliers in order that the sale of such materials and equipment be properly recorded as a tax-exempt sale.

SC-6.12

Record Documents:

Delete the last sentence of Paragraph 6.12.A. in its entirety and insert the following in its place:

Upon Substantial Completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

SC-6.16

Emergencies:

Add the following new paragraph immediately after Paragraph 6.16.A.:

B. In emergencies affecting the safety or protection of persons or property or maintenance of temporary construction at the Site or adjacent thereto, and Contractor cannot be reached, Owner may act to attempt to prevent threatened damage, injury, or loss. Owner will give Contractor and Engineer prompt written notice of such action and the cost of the correction

or remedy shall be charged against Contractor. A Change Order will be issued to document the change in Contract Price.

SC-6.17

Shop Drawings and Samples:

Add the following new paragraphs immediately after Paragraph 6.17.E.:Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.

F. After Engineer has reviewed and approved a Shop Drawing or Sample, Contractor shall provide the material or equipment approved. Engineer will not review subsequent submittals of a different manufacturer or Supplier unless Contractor provides sufficient information to Engineer that the approved material or equipment is unavailable, time of delivery will delay the construction progress but not as a result of Contractor's failure to timely pursue the Work or to coordinate various activities properly, or Owner requests a different manufacturer or Supplier.

ARTICLE 7. OTHER WORK

SC-7.4

Claims Between Contractors:

Add the following new paragraphs immediately after Paragraph 7.3.:

A. Should Contractor cause damage to the work or property of any other contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner, Engineer, or Engineer's Consultants, then Contractor (without involving Owner, Engineer or Engineer's Consultants) shall either (1) remedy the damage, (2) agree to compensate the other contractor for remedy of the damage, or (3) remedy the damage and attempt to settle with such other contractor by agreement, or otherwise resolve the dispute by arbitration or at law.

B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, Engineer's Consultants and the officers, directors, partners, employees, agents and other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any other contractor against Owner, Engineer, or Engineer's

Consultants to the extent said claim is based on or arises out of Contractor's performance of the Work. Should another contractor cause damage to the Work or property of Contractor or should the performance of work by any other contractor at the Site give rise to any other Claim, Contractor shall not institute any action, legal or equitable, against Owner, Engineer, or Engineer's Consultants or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner, Engineer, or Engineer's Consultants on account of any such damage or Claim.

C. If Contractor is delayed at any time in performing or furnishing the Work by any act or neglect of another contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a Claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, Engineer, and Engineer's Consultants for any delay, disruption, interference, or hindrance caused by any other contractor. This paragraph does not prevent recovery from Owner, Engineer, or Engineer's Consultants for activities that are their respective responsibilities.

SC-7.5

Damages to the Work or Property:

Add the following new paragraph at the end of Article 7 of the General Conditions:

A. Should Contractor cause damage to the work or property of any separate contractor at the site, or should any claim arising out of Contractor's performance of the Work at the site be made by any separate contractor against Contractor, Owner, Engineer, Engineer's Consultants, or any other person, Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by arbitration or at law. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold Owner, Engineer, and Engineer's Consultants, harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals, and court and arbitration costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any separate contractor against Owner, Engineer, or Engineer's Consultants, to the extent based on a claim arising out of the Contractor's performance of the Work. Should a separate contractor cause damage to the Work or property of Contractor or should the performance of Work by any separate contractor at the site give rise to any other claim, Contractor shall not institute any action, legal or equitable, against Owner, Engineer or Engineer's Consultants, or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner, Engineer, or Engineer's Consultants, on such damage or claim. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor and Owner and Contractor are unable to agree to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner,

Engineer, and Engineer's Consultants, for any delay, disruption, interference or hindrance caused by any separate contractor. This paragraph does not prevent recovery from Owner, Engineer, or Engineer's Consultant, for activities that are their respective responsibilities.

ARTICLE 8. OWNER'S RESPONSIBILITIES

SC-8.6

Insurance:

Delete paragraph 8.6 of the General Conditions in its entirety.

ARTICLE 9. ENGINEER'S STATUS DURING CONSTRUCTION

SC-9.3

Project Representative:

Add the following new paragraphs immediately after Paragraph 9.3.A.:

B. The Resident Project Representative (RPR) will be Engineer's employee or agent at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR'S actions. RPR'S dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR'S dealings with Subcontractors shall be through or with the full knowledge and approval of Contractor. The RPR shall assist with the following CM related tasks as necessary and as applicable:

1. *Schedules:* Review the progress schedule, schedule of Shop Drawing and Sample submittals, and schedule of values prepared by Contractor and consult with Engineer concerning acceptability.

2. *Conferences and Meetings:*

    a. Preconstruction conference with Owner, Contractor(s), Utilities, and other appropriate parties affected by the Project.

    b. Attend meetings with Contractor, such as progress meetings, job conferences and other Project related meetings.

3. *Liaison:*

    a. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, assist in providing information regarding the intent of the Contract Documents.

    b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's On-Site operations.

c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

d. Direct visiting inspectors representing public or other agencies having jurisdiction over the Project to Owner or Contractor as appropriate.

4. *Interpretation of Contract Documents:* Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

5. *Shop Drawings and Samples:*

a. Record date of receipt of Samples and approved Shop Drawings.

b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

6. *Modifications:* Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR'S recommendations, to Engineer. Transmit to Contractor, in writing decisions as issued by Engineer.

7. *Review of Work and Rejection of Defective Work:*

a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress will not produce a completed Project that conforms generally to the Contract Documents or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

8. *Inspections, Tests, and System Startups:*

a. Verify that tests, equipment, and systems startups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.

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

9. *Records:*

a. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

b. Maintain records for use in preparing Project documentation.

10. *Reports*:

a. Furnish to Engineer periodic reports as required of progress of the Work and Contractor's compliance with the progress schedule and schedule of Shop Drawing and Sample submittals.

b. Draft and recommend Engineering proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition.

11. *Payment Requests:* Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. *Certificates, Operation and Maintenance Manuals*: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the times actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

13. *Completion:*

a. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and the preparation of list of items to be completed or corrected.

b. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final list of items to be completed and deficiencies to be remedied.

c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the Notice of Acceptability of the Work.

d. Coordinate efforts required to prepare record drawings showing those changes made during construction, based on the marked-up prints, drawings and other data furnished by Contractor to Engineer and which Engineer considers significant.

C. The RPR shall not:

1. Authorize any deviations from the Contract Documents or substitution or materials or equipment (including "or equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, Suppliers, or Contractor's superintendent.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work unless such advice or directions are specifically required by the Contract Documents.

5. Advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Accept Shop Drawings or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or part.

SC-9.7

Determinations for Unit Price Work:

Delete the last sentence of Paragraph 9.7.A. in its entirety and insert the following in its place:

"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 and not subject to appeal."

SC-9.10

Compliance with Safety Program:

Add the following new paragraph immediately after Paragraph 9.10.A.:

B. In the event Engineer determines that Contractor's safety plans, programs, and procedures do not provide adequate protection for Engineer, Engineer may direct its employees to leave the Project Site or implement additional safeguards for Engineer's protection. If taken, these actions will be in furtherance of Engineer's responsibility to its own employees only, and Engineer will not assume any responsibility for protection of any other persons affected by

the Work. In the event Engineer observes situations which appear to have potential for immediate and serious injury to persons, Engineer may warn the persons who appear to be affected by such situations. Such warnings, if issued, shall be given based on general humanitarian concerns, and Engineer will not, by the issuance of any such warning, assume any responsibility to issue future warnings or any general responsibility for protection of persons affected by the Work.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

SC-10.1

Authorized Changes in the Work:

Add the following new subparagraph immediately after Paragraph 10.1.B.:

1. By submission of a Claim, Contractor certifies that the claim is made in good faith, that the supporting data are accurate and complete to the best of Contractor's knowledge and belief, and that the amount or time requested accurately reflects the Contract adjustment for which Contractor believes Owner is liable.

SC-10.5

Claims:

Amend Paragraph 10.5.B. by deleting the words "30 days" in the first sentence and inserting the words "10 days" in their place, and deleting the words "60 days" in the third sentence and inserting the words "30 days" in their place.

Amend the sixth sentence of Paragraph 10.5.B. by deleting the words "believes it."

ARTICLE 11. COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

SC-11.1

Cost of the Work:

In the second sentence of paragraph 11.1A.1 delete the word "superintendents".

Delete Paragraph 11.3D.1 in entirety.

ARTICLE 12. CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

SC-12.1

Change in Contract Price

Delete Paragraph 12.1.B.2. in its entirety and insert the following in its place:

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which includes an allowance for overhead and profit in accordance with Paragraph 12.1.C.2); or

SC-12.1

Change of Contract Price:

Delete the semicolon at the end of Paragraph 12.1.C.2.c., and add the following language:

", provided, however, that on any subcontracted work the total maximum fee to be paid by Owner under this subparagraph shall be no greater than 27 percent of the cost incurred by the Subcontractor who actually performed the work";

SC-12.2

Change of Contract Times:

Add the following new paragraph immediately after Paragraph 12.2.B.:

C. Time extensions provided under Paragraph 12.3 of the General Conditions will only be allowed for controlling items of Work (critical path).

SC-12.3

Delays:

Delete Paragraph 12.3.B. in its entirety and insert the following in its place:

B. If Owner, Engineer, or other contractors or utility owners performing other work for the Owner as contemplated by Article 7, 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 an equitable adjustment in the 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 with the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.2.B.

ARTICLE 14. PAYMENTS TO CONTRACTOR AND COMPLETION

SC-14.2

Progress Payments:

Amend the first sentence of Paragraph 14.2.A.1. by striking out the words "20 days" and inserting the words "30 days" in their place. Also strike out the phrase "(but not more often than once a month)"

SC-14.2

Progress Payments:

Add the following language at the end of Paragraph 14.2.A.2.:

Owner may at any time require Contractor to furnish lien waivers for labor and materials covered by specified Applications for Payment.

SC-14.2

Payment Becomes Due:

Amend Paragraph 14.2.C.1. by striking out the words "Ten days" and inserting the words "Twenty days" in their place.

SC-14.4

Substantial Completion:

Add the following new paragraphs immediately after Paragraph 14.4.A.:

1. Contractor's request for issuance of a Certificate of Substantial Completion shall include schedules, guarantees, maintenance and operations instructions, Bonds, certificates or other evidence of insurance required by Paragraph 5.4.B.6, certificates of inspection, affidavit of wage rate compliance, marked-up record documents (as provided in Paragraph GC 6.12) and other documents.

SC-14.7

Final Payment:

Amend the first sentence of Paragraph 14.7.A.1. by striking out the words "and has delivered in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked up record documents (as provided in Paragraph 6.12), and other documents,"

Amend Paragraph 14.7.A.2.a. by striking out the words ", including but not limited to evidence of insurance required by Paragraph 5.4.B.6."

SC-14.7

Final Payment:

Add the following new paragraph after paragraph 14.7A.3 of the General Conditions.

4. The amount of retainage with respect to final payment will be as stipulated in the Agreement.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

SC-15.4

Contractor May Stop Work or Terminate:

Amend Paragraph 15.4.A. by striking out the words "30 days" in two places and inserting the words "60 days" in their places, and by striking out the words "seven days" and inserting the words "10 days" in their place.

Amend Paragraph 15.4.B. by striking out the words "30 days" in two places and inserting the words "60 days" in their places, and by striking out the words "seven days and inserting the words "10 days" in their place.

ARTICLE 16. DISPUTE RESOLUTION

SC-16.1

Methods and Procedures:

Add a new sentence at the end of paragraph 16.1A of the General Conditions which is to read as follows:

> Contractor shall carry on the Work and maintain the progress schedule during the dispute resolution proceedings unless otherwise agreed in writing by Owner and Contractor.

SC-16.1

Methods and Procedures:

Delete Paragraph 16.1.C in its entirety and insert the following in its place:

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.5.C. or a denial pursuant to Paragraphs 10.5.C.3. or 10.5.D. shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. Elects in writing to demand arbitration of the Claim, pursuant to Paragraph SC-16.2.

2. Agrees with the other party to submit the Claim to another dispute resolution process.

Add the following new paragraphs immediately after Paragraph 16.1.:

SC-16.02

Arbitration:

A. All Claims or counterclaims, disputes, or other matters in question between Owner and Contractor arising out of or relating to the Contract Documents or the breach thereof

(except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.9) including but not limited to those not resolved under the provisions of Paragraphs SC-16.1A and 16.1.B will be decided by arbitration in accordance with the laws of the State of Michigan**,** subject to the conditions and limitations of this Paragraph SC-16.2. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the 30-day period specified in Paragraph SC-16.1.C, and in all other cases within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statute of limitations.

C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joiner, or in any other manner any other individual or entity including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. The inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration.

2. Such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include: (i) a concise breakdown of the award; and (ii) a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.

E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Controlling Law relating to vacating or modifying an arbitral award.

F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.

ARTICLE 17. MISCELLANEOUS

SC-17.6

Delete paragraph 17.6 in its entirety and replace with the following:

17.6 Headings:

A. The headings or titles of any article, paragraph, subparagraph, section, subsection, or part of the Contract Documents shall not be deemed to limit or restrict the article, paragraph, section, or part.

SC-17.7

Legal Address of Contractor:

Add new paragraph immediately after paragraph 17.6 of the General Conditions as follows:

A. Contractor's business address and his office at or near the site of the Work are both hereby designated as places to which communications shall be delivered. The depositing of any letter, notice, or other communication in a postpaid wrapper directed to the Contractor's business address in a post office box regularly maintained by the Post Office Department or the delivery at either designated address of any letter, notice, or other communication by mail or otherwise shall be deemed sufficient service thereof upon Contractor, and the date of such service shall be the date of receipt. The first-named address may be changed at any time by an instrument in writing, executed and acknowledged by Contractor and delivered to Engineer. Service of any notice, letter, or other communication upon the Contractor personally shall likewise be deemed sufficient service.

SC-17.8

Engineering and Inspection Costs and Expenses:

Add a new paragraph immediately after paragraph 17.7 of the General Conditions which is to read as follows:

A. The Contractor shall be responsible and liable for all engineering and inspection costs and expenses incurred by the Owner caused by, or related in any way to, the failure of the Contractor to perform its services in the time and manner set forth in the Agreement, the General Conditions and the Supplemental Conditions. The Owner may charge to the Contractor, and may deduct from the periodical payments and the final payment for the Contractor's work, the full amount of such engineering and inspection costs and expenses including Owner's and Engineer's costs.

    1. The Engineer's charges will be based on the Engineer's actual labor and expenses at the same rate the Owner is charged.

B. For any engineering costs and expenses beyond the regular eight-hour day and for any time work on Saturday, Sunday, or holidays, the charges for such personnel will be one and one-half times the rate established above.

END OF SECTION

SECTION 01 43 33
ROOFING MANUFACTURER'S FIELD SERVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 07 Specification Sections apply to this Section.

1.2 SUMMARY

A. Section includes Manufacturer's field services for roofing assemblies.

B. Related Sections:
1. Section 07 05 00 – Common Work Results for Thermal and Moisture Protection.

C. Related Work Specified Elsewhere:
1. Roofing Material: Section 07 55 00- Protected Membrane Roofing

1.3 REFERENCES

A. International building Code (current edition) or local authority building code.

B. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Buildings and Other Structures.

C. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

D. American National Standards Institute and Single Ply Roofing Institute (ANSI/SPRI): ANSI/SPRI ES-1 Testing and Certification Listing of Shop Fabricated Edge Metal.

1.4 SUBMITTALS FOR REVIEW

A. Product Data: Provide manufacturer's technical product data for each type of roofing product specified. Include data substantiating that materials comply with specified requirements.

B. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

C. Roofing System Manufacture's Evaluation: Provide a comprehensive written assessment comparing available roofing solutions with validation of why the roofing system selection for the specific project is suitable and appropriate.

D. Roofing System Manufacturer's Report Form: Provide a copy of the report form utilized by the roofing system manufacturer for progress inspections to monitor installation and quality.

E. Online Reporting Capabilities: Provide a sample of the roofing system manufacturer's online roof inspection report as well as information about how long inspection reports are available to owner.

1.5 SUBMITTALS FOR INFORMATION

A. Manufacturer's Installation Instructions: Submit installation instructions and recommendations indicating special precautions required for installing the membrane.

B. Manufacturer's Certificate: Certify that roof system furnished is approved by Factory Mutual Global, Underwriters Laboratories, Warnock Hersey or approved third party testing facility.

C. Manufacturer's Certificate: Certify that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

D. Manufacturer's Certificate: Submit a certified copy of the roofing manufacturer's ISO 9001 compliance certificate.

E. Written certification from the roofing system manufacturer certifying the applicator is currently authorized for the installation of the specified roof system.

F. Design Loads: Submit copy of manufacturer's minimum design load calculations according to ASCE 7, Method 2 for Components and Cladding. In no case shall the design loads be taken to be less than those detailed in Design and Performance Criteria article of this specification.

G. Qualification data for firms and individuals identified in Quality Assurance Article below.

H. Test Reports: Submit ANSI/SPRI ES-1 Testing and Certification Listing of Shop Fabricated Edge Metal Products.

I. Substitutions: Products proposed as equal to the products specified for this project shall meet all of the requirements in the appropriate Division 7 specifications and shall be submitted for consideration at least 7 days prior to the date that bids must be submitted.
   1. Proposals shall be accompanied by a copy of the manufacturer's standard specification Section. That specification Section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.
   2. Manufacturer's checklist will be accompanied with any substitution to verify equal performance characteristics to those specified in Division 7 specification.
   3. The Owner's decision regarding substitutions will be considered final.

1.6 CONTRACT CLOSEOUT SUBMITTALS

A. Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.

B. Roofing Maintenance Instructions: Provide a roof care and maintenance manual of manufacturer's recommendations for maintenance of installed roofing systems.

C. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

D. Inspection Logs: Copy of inspection reports as performed by the manufacturer shall be submitted at project closeout and include photographic documentation of installation progress, weather conditions, and personnel on the project at the time of every inspection.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with not less than [12] years documented experience and have ISO 9001 certification.

B. Installer Qualifications: Company specializing in specified roofing installation with not less than [5] years experience and authorized by roofing system manufacturer as qualified to install manufacturer's roofing materials.

C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress. Maintain proper supervision of workmen.

D. Maintain a copy of the roof plans, details, and specifications in the possession of the Supervisor/Foreman and on the roof at all times.

E. Source Limitations: Obtain all primary components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.
   1. The manufacturer providing the roofing system warranty must verify that they manufacture a minimum of 75% of the products utilized in the roofing system of this project. Products that are private labeled shall not be considered as manufactured by the roofing system supplier.
   2. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

F. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001.

1.8 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Roofing Conference: Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of roofing system installation and associated work.

B. Require attendance of installer of each component of associated work: installers of deck or substrate construction to receive roofing work: installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any): architect and/or engineer: owner: roofing system manufacturer's full time employee: and other representatives directly concerned with performance of the Work, including (where applicable) owner's insurers, testing agencies and governing authorities. Objectives of conference include:
   1. Review foreseeable methods and procedures related to roofing work, including set up and mobilization areas for stored material and work area.
   2. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by others.
   3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
   4. Review roofing system requirements (drawings, specifications and other contract documents).
   5. Review required submittals both completed and yet to be completed.

6. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
7. Review required inspection, testing, certifying and material usage accounting procedures.
8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
9. Record discussion of conference including decisions and agreements (or disagreements) reached and furnish a copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

C. The Owner's Representative will designate one of the conference participants to record the proceedings and promptly distribute them to the participants for record.

D. The intent of the conference is to resolve issues affecting the installation and performance of roofing work. Do not proceed with roofing work until such issues are resolved to the satisfaction of the owner and Architect of record. This shall not be construed as interference with the progress of Work on the part of the owner or Architect of Record.

1.9 MANUFACTURER'S INSPECTIONS

A. When the Project is in progress, a full-time employee of the roofing system manufacturer must provide the following:
1. Report progress and quality of the work as observed.
2. Provide periodic (3-5 days per week) roofing installation inspections: Inspections must include; photographic documentation of work in-progress and written statements of compliance with details/shop drawings.
3. Report to the owner, architect and/or engineer in writing any failure or refusal of the contractor to correct unacceptable practices called to the contractor's attention.
4. Confirm after project completion that the manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.10 WARRANTY

A. Upon completion of installation, and acceptance by the owner and architect and/or engineer, the manufacturer will supply to the owner the specified warranty.

B. Installer will submit a two (2)- year workmanship warranty to the membrane manufacturer with a copy directly to the owner.

C. The roofing system manufacturer must have been in continuous business operation for a period of time at least as long as the length of the roof system warranty provided for this project.

1.11 DESIGN AND PERFORMANCE CRITERIA

A. Uniform Wind Uplift Load Capacity (required for each roof section)
1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
Attachment shall be installed exactly as given in Part 3.

a. Design Code: ASCE 7-05, Method 2 for Components and Cladding
b. Wind Up-Lift calculations provided.

B. Snow Load: 25 psf.

C. Live Load: 20 psf, or not to exceed original building design.

D. Drainage Calculations: Drainage shall be calculated for all roof areas to determine suitability of all plumbing and gutter accommodations are sized appropriately to manage storm water runoff.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXECUTION, GENERAL

A. Comply with requirements of related Division 07 Section.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required by code, install and test the roofing system to comply with governing regulation and specified insurance requirements.

3.3 FIELD QUALITY CONTROL

A. Roofing Manufacturer Representative shall perform field inspection as specified in Article titled: MANUFACTURER'S INSPECTIONS above. Inspections must include photographic documentation of installation progress, weather conditions, and personnel on the project at the time of inspection.

B. Correct defects or irregularities discovered during field inspection. Issues deemed defective must be re-inspected and determined suitable by the roofing manufacturer.

C. Require attendance of roofing materials manufacturers' representatives at site during installation of the roofing system. A copy of the specification shall also be on site at all times.

D. Frequent progress meetings shall be conducted during the performance of roof system installation and must be attended by the owner, architect or engineer, roofing system manufacturer's full time employee, and other representatives directly concerned with performance of the work.

3.4 FINAL INSPECTION

A. At the completion of the roofing installation and associated work, meet with contractor, architect or engineer, installer, installer of associated work, owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. Notify the Architect upon completion of corrections.

D. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the roofing contractor.

E. If core cuts verify the presence of damp or wet materials, the roofing contractor shall be required to replace the damaged areas at his own expense.

F. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

G. Immediately correct roof leakage during construction. If the contractor does not respond within twenty four (24) hours, the owner may exercise right to correct the Work under the terms of the Conditions of the Contract.

END OF SECTION

01 22 00 **UNIT PRICE** **01 22 00**
01 22 13 METHOD OF MEASUREMENT 01 22 13

A. General
Quantities of work completed under the contract will be measured by the Engineer according to United States standard measures unless otherwise noted.

Quantities of materials furnished and of work performed under the contract will be determined by methods of measurement and computations that are generally recognized as conforming to good engineering practice.

1. Aggregates furnished and measured by weight will paid including an allowance for moisture of up to six [6%] percent moisture. Where aggregate field tests indicate moisture content is greater than 6%, a payment adjustment shall be made. The excess weight above 6% moisture shall be deducted from the scale weights.
2. In-place cubic yard (ICY) shall be the volume based on field survey data and the "average end area" methods.
3. Truck cubic yard (TCY) shall be the volume of each specific truck bed by design. Based on the full volume of each truck bed level with the top rail.
   a. Each truck removing material from the site shall:
      1) _____ mark designation
      2) _____ Owner
      3) _____ Bed volume struck
4. Tons: (2,000 pounds) as recorded on weight scales having a "Department of Agriculture" certificate valid for one year at the time of weighing. Payment for this Work shall be made on the basis of weight tickets noting project, contractor, time, date, gross, tare and net weights.

All items of work for this contract will be measured in units as indicated on the Proposal and as noted herein. CF, cubic feet; CYD, cubic yard; EA, each; LS., lump sum; LF., linear feet; SYD, square yard; SF., square feet; T, Ton (2000 lb.); AC, acre 43560 sf; ICY, in-place cubic yard; TCY, truck cubic yard.

01 22 16 UNIT PRICE PAY ITEMS **01 22 16**

Item No. 1 Concrete Patching

Payment for this item shall include all labor, material and equipment necessary to prepare the surface, place bonding coating, place concrete, formwork as necessary, clean debris and cure concrete patching per Detail 1/S1.1 on sheet S1.1. The completed work shall be paid for at the contract unit price.

Item No. 2 Concrete Crack Repair

Payment for this item shall include all labor, material and equipment necessary to complete the concrete crack repair by grout injection. This item shall include material labor equipment, injection site preparation and cleanup necessary to complete the process as shown on Detail 2/S1.1 sheet S1.1. The completed work shall be paid for at the contract unit price.

Item No. 3 Top Slab Expansion Joint Repair

Payment for this item shall include all labor, material and equipment necessary to complete the top slab expansion joint repair including excavation, water proofing, backer rod, joint filler, backfill, top soil seed and mulch and restoration necessary to complete the repair per Detail 3/S1.2 on sheet S1.2. The maximum weight of equipment allowed on top of the reservoir will be limited to 4,000 Lbs. The depth of fill over the reservoir is approximately 30 inches. The completed work shall be paid for at the contract unit price.

Item No. 4 Exterior Wall and Base Slab Expansion Joint Repair

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the exterior wall and base slab expansion joint repair per Detail 4/S1.2 as shown on sheet S1.2. The completed work shall be paid for at the contract unit price.

Item No. 5 Interior Wall Expansion Joint Repair

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the interior wall expansion joint repair per Detail 5/S1.3 as shown on sheet S1.3. The completed work shall be paid for at the contract unit price.

Item No. 6 Column Repair

Payment for this item shall include all labor, material, reinforcing steel, concrete, formwork, cleaning and equipment necessary to complete the column repair with shown reinforcing steel per Detail 6/S1.4 and A/S1.4 as shown on sheet S1.4. The completed work shall be paid for at the contract unit price.

Item No. 7 Roof Slab Bottom Coating

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the coating of the bottom side of the roof slab per Note 3 on sheet S1.0. The completed work shall be paid for at the contract unit price.

Item No. 8 Concrete Column Delaminated Repair

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the repair of delaminated concrete on columns. per Note 6 on sheet S1.0. The completed work shall be paid for at the contract unit price.

Item No. 9 Concrete Column Coating

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the coating of concrete on columns. per Note 6 on sheet S1.0. The completed work shall be paid for at the contract unit price

Item No. 10 Concrete Cores and Testing

Payment for this item shall include all labor, material, cleaning and equipment necessary to complete the cores and testing of the core samples per Note 8 on sheet S1.0. The completed work shall be paid for at the contract unit price

01 26 00 CONTRACT MODIFICATIONS 01 26 00

1.01 SUMMARY

A. This Section includes forms/documents to be used for modifying/changing this Contract.
1. Forms shall be used by the Contractor or Engineer as needed.
2. Pay Application Forms should be submitted on EJCDC form C-620
3. Field Orders (FO) shall be submitted on EJCDC Form C-942
4. Change Order (CO) shall be submitted on EJCDC Form C-941

1.02 REFERENCES

A. Definitions:

RFI: Request for Interpretation
Initiated by Contractor and processed by the Engineer.
FO: Field Order (EJCDC Form C-942)
Initiated by Engineer for Contractor’s immediate action (variance from contact, future actions, impacting this project)
Bulletin: Proposal Request
Initiated by Engineer requesting new/additional pricing for an anticipated/changing of the Contract Work
CO: Change Order (EJCDC Form C-941)
This document changes the Contract/Agreement Amount. All other forms can be supporting documents especially FO and Bulletins.
SMS: Stored Material Summary
Part of the Contractor’s Pay application form EJCDC C-620

01 29 00 **PAYMENT PROCEDURES** **01 29 00**

01 29 73 PAYMENT SUBDIVISIONS 01 29 73

A. Payment application shall be supported by Work subdivisions:
   1. Unit prices as noted in the proposal/ agreement or
   2. Schedule of Values. Shall be a subdivision of cost of Work, listed in the Proposal, and/or the further subdividing of the proposal cost by technical specifications categories; agreed between the Contractor and the Engineer.

01 29 76 PAYMENT PROCEDURES 01 29 76

A. Payment Application shall be submitted on the "Contractor's Application for Payment" form EJCDC- C-620. The Application shall list the 'Unit Prices' or 'Schedule of Values'. The sum of the extended 'unit prices' or the 'schedule of values' shall equal the agreed "Contract Prices".

B. Other Attachments to the "Contractors Application for Payment" shall be as listed"
   1. Noted in the Supplementary Conditions art .SC- 6.00 'Contractors Responsibilities
   2. Required by Funding Agencies.

C. Contractual Payment and Retainage Procedure are further delineated.

   00 55 00 – Agreement, article (retainage)
   00 72 13 – General Conditions, Article 14
   00 73 16 – Supplementary Conditions: SC 14.02c (time)

01 31 00 PROJECT MANAGEMENT AND COORDINATION 01 31 00

01 31 13 PROJECT COORDINATION 01 31 13

1. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
2. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

01 31 19 MEETINGS 01 31 19

A. Pre-Construction Meeting: Owner/Engineer are responsible for initiating this meeting.
   1. Engineer will schedule a meeting after Notice of Award.
   2. Attendance Required: Owner, Engineer and Contractor.
   3. Agenda:
      a. Execution of Owner-Contractor Agreement.
      b. Distribution of Contract Documents.
      c. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
      d. Designation of personnel representing the parties in Contract and the Engineer.
      e. Procedures and processing of field decisions, submittals, and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
      f. Scheduling.
      g. Use of premises by Owner and Contractor.
      h. Owner's requirements.
      i. Construction facilities and controls provided by Owner.
      j. Survey and construction layout.
      k. Security and housekeeping procedures.
      l. Procedures for testing.
      m. Procedures for maintaining record documents.
      n. Requirements for start-up of equipment.
      o. Inspection and acceptance of equipment put into service during construction period.
   4. Engineer will record minutes and distribute copies within five days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

B. Progress Meetings: Engineer/Owner are responsible for initiating Progress Meetings:
   1. Schedule and administer meetings throughout progress of the Work at monthly intervals. At request of Owner or Engineer, interval may be increased to bi-monthly.
   2. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
   3. Attendance Required: Job superintendent, major Subcontractors and suppliers, and Owner, and/or Engineer, as appropriate to agenda topics for each meeting.
   4. Agenda:
      a. Review minutes of previous meetings.
      b. Review of Work progress.
      c. Field observations, problems, and decisions.
      d. Identification of problems which impede planned progress.
      e. Review of submittals schedule and status of submittals.
      f. Review of off-site fabrication and delivery schedules.
      g. Maintenance of progress schedule and schedule changes.
      h. Corrective measures to regain projected schedules.
      i. Planned progress during succeeding work period.
      j. Coordination of projected progress.
      k. Maintenance of quality and work standards.
      l. Effect of proposed changes on progress schedule and coordination.
      m. Conflicts with adjacent construction contracts.
      n. Other business relating to Work.
      o. Status of Federal requirements
   5. Record minutes and distribute copies within five days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION 01 32 00

01 32 16 CONSTRUCTION PROGRESS SCHEDULE 01 32 16

A. Prepare a “Bar Chart Schedule” with separate lines for each major portion of the Work operation as Work area identifying the first work day of each week.
   1. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
   2. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.
B. Submit Progress Schedule:
   1. Submit initial schedule in duplicate within 15 days after date established in Notice to Proceed.
   2. Submit revised schedules with each Application for Payment, identifying changes since previous version.

01 32 17 PROPOSED PRODUCT LIST 01 32 17

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

01 33 00 SUBMITTAL PROCEDURES 01 33 00

01 33 02 SPECIFIED SUBMITTALS 01 33 02

When specified in the Technical Specification sections, submit the following to the Engineer for project records.

A. Design Data
B. Test Reports
C. Manufacturers Instructions:
   1. Submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.
   2. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
D. Manufacturers Field Reports:
   1. Submit report within 30 days of observation to Architect/Engineer for information.
   2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
E. Certificates:
   1. Submit certification by the manufacturer, installation/application Subcontractor, or the Contractor to Engineer, in quantities specified for Product Data.
   2. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   3. Certificates may be recent or previous test results on material or Product but must be acceptable to Engineer.

TRANSMITTAL FOR ACCEPTANCE OF SHOP AND VENDOR DRAWINGS ….. 01 33 03						
Date	Project Name and Contract No.				Location	Submittal No.
Submittal Type: HC – Hard Copy □ or Electronic □						
To:	Johnson & Anderson, Inc. (a DLZ Company)		From:			
	4494 Elizabeth Lake Road					
	Waterford, MI 48328					
Attn: , P.E.			Contractor/Vendor Job No.			
No. Copies	Item No.	Description (Name, Type, Size, Capacity Use)	Spec. Sect. No.	Manufacturer/ Designer	J&A Action Code	J&A Review
Special Instructions by Contractor/Vendor			Johnson & Anderson Comments			
Checked by Contractor for Project Conformance:						
Signed:/Title:						
Acceptance Action Code:						
1. Approved 2. Approved as noted.		■ Installation shall proceed only when acceptance code is #1 or #2.				
3. Revised and resubmit. 4. Rejected – see remarks.		■ Acceptance coded 3 or 4 shall be resubmitted unless otherwise noted.				Date Returned by Johnson & Anderson, Inc.
Approval is only for conformance with the design concept of the Project and compliance with the information given in the Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at the job site; for information that pertains solely to the fabrication processes or to techniques of constructions; and for coordination of the work of all trades.						
IN-HOUSE SHOP DRAWING AND VENDOR DRAWING REVIEW						
Seq.	Discipline	Individual	Initial	Date	Comments	
	Project Manager				Review Period _____ days	
	Civil					
	Structural/Arch.					
	Electrical/Instr.					
	Mechanical					
	Process					

01 43 00 QUALITY ASSURANCE 01 43 00

01 43 10 CONTRACTOR CONTROL 01 43 10

A. This Section includes requirements and procedures for Quality Assurance activities for the project.
B. Related Requirements:
   1. Submittals Section 01-33-00.
   2. Technical Specifications 03 01 30 and 03 30 53.
C. Administration:
   1. Contractor Control of Installation:
      a. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
      b. Comply with manufacturers' instructions, including each step-in sequence. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
      c. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
      d. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
      e. Perform Work by persons qualified to produce required and specified quality.
   2. Schedule field list/observations with notification to the Engineer.

01 51 00 TEMPORARY UTILITIES 01 51 00

01 51 01 TEMPORARY UTILITIES 01 51 01

A. Section Includes:
   1. Temporary electricity, lighting, fire protection, heat, ventilation, telephone service, water.
B. Related Requirements:
   1. Contract Closeout: Final cleaning (01 74 23).
   2. Construction Facilities (01 52 00).

01 51 02 COST OF UTILITIES 01 51 02

A. Contractor shall pay for all utility costs/charges necessary for the work.
B. Where utility charges are measured through connection in the Owner's name: The Contractor shall reimburse the Owner based on actual billing charges.

01 51 03 COORDINATION 01 51 03

A. Contractor shall schedule and coordinate the utility services as required to complete the work.

01 51 04 ELECTRICITY AND LIGHTING 01 51 04

A. Available Electrical Service:
   1. One 120-volt 20-amp connection is available at the site.
   2. Any additional electrical requirements shall be furnished by the contractor.
B. Temporary electricity: provide branch wiring from power to distribution boxes with connectors for power, lighting conductors, pigtails and lamps.
B. Temporary Lighting:
   1. Provide and maintain lighting for construction operations at levels sufficient to meet requirements of the work being done, and in compliance with all applicable safety codes.
   2. Provide and maintain 1 watt/sq. ft. lighting to exterior staging and storage areas after dark for security purposes.
   3. Maintain lighting and provide routine repairs.
   4. Permanent building lighting may be utilized during construction. In such cases, the lighting fixtures shall be re-lamped at final project acceptance.

01 51 05 TEMPORARY HEATING AND VENTILATING 01 51 05

A. Heating:
   1. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
B. Ventilating:
   1. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

01 51 06 TEMPORARY WATER SUPPLY 01 51 06

A. Provide and maintain suitable quality water service required for construction operations at time of project mobilization.

01 51 07 CLOSEOUT 01 51 07

A. Temporary Utility Removal:
   1. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment.
   2. Clean and repair damage caused by installation or use of temporary utilities.

01 52 00 CONSTRUCTION FACILITIES 01 52 00

A. This Section specifies temporary facilities and controls necessary for the Work completion.
B. Related Requirements:
   1. Temporary Utilities 01-51-00.
   2. Storage Areas 01-55-29.
   3. Contract Closeout 01-74-00.

01 52 10 SANITARY FACILITIES 01 52 10

A. Necessary sanitary convenience for the use of workmen on the work, properly secluded from public observation, shall be constructed and maintained in sanitary condition by the Contractor, and their use shall be strictly enforced. He shall also furnish a convenient supply of drinking water from a safe and wholesome source.

01 74 00 CLEANING & WASTE MANAGEMENT 01 74 00

01 74 13 PROGRESS CLEANING 01 74 13

The Contractor shall keep the work area and all property occupied by him in neat and orderly condition at all times. Waste materials, rubbish, and debris shall not be allowed to accumulate. Contractor's equipment, temporary buildings, scaffolding and excess materials shall be promptly removed as they become no longer needed for the progress of the work. At the completion of construction, the work area shall be left raked clean. If, in the opinion of the Engineer, cleanliness of the project is not progressing in a reasonable manner, he shall have the right to direct the Contractor to proceed with such work, or any portion thereof, immediately.

01 74 17 SITE MAINTENANCE 01 74 17

Material or equipment delivered on the streets shall be neatly and compactly placed along the sides of the roadway in such a manner so as to cause the least inconvenience to the property owners and to the general public. The Contractor shall erect a material storage shed or sheds necessary as required for the proper storage of materials subject to damage by weathering.

01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL 01 74 19

Construction Waste Management and Disposal: All materials in excess of the quantity required for backfilling and all materials unsuitable for backfilling shall be hauled away by the Contractor. It shall be the responsibility of the Contractor to obtain such spoil sites as may be required. The Contractor shall leave such spoil sites in a neat and generally level condition satisfactory to the Engineer.

A. Waste Disposal: Contractor is responsible to provide trash containers and fund the removal/disposal of construction debris and general trash. Contractor is also responsible for the proper collection, labeling, transporting, manifesting and disposal of polluting or hazardous wastes such as solvents, paints, oil or antifreeze (and rags contaminated with any of these materials), per 40 CFR Part 261 and Michigan Act 64 of 1979. Copies of all manifests should remain available for Owner review upon request. Under no circumstances may hazardous wastes be disposed of in Owner-owned dumpsters, waste containers, drains or sewers, or drained onto roads, parking lots, ditches, wetlands, dirt piles or other soil.

B. Spills and Accidents: Contractor must immediately notify the Owner in the event that its activities result in a (non-negligible) spill of a hazardous material, or an accident or an injury (to any individual). Contractor must complete the Report and return it to the Engineer within twenty-four (24) hours of occurrence.

01 74 23 FINAL CLEANING 01 74 23

Execute final cleaning prior to final project assessment/closeout.

A. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
C. Replace filters of operating equipment, as necessary.
D. Clean debris from roofs, gutters, downspouts, and drainage systems.
E. Clean site; sweep paved areas, rake clean landscaped surfaces.
F. Remove waste and surplus materials, rubbish, and construction facilities from the site.

01 77 00 CLOSEOUT PROCEDURES 01 77 00

01 77 13 SUBSTANTIAL COMPLETION 01 77 13

A. When the Contractor considers the Work is substantially complete, he may submit to Engineer:
   1. A written notice that the Work is substantially complete, he may submit to Engineer.
   2. A list of items to be completed or corrected.

B. Engineer together with Owner's Representative will make an inspection, within a reasonable time after receipt of such notice, to determine the status of completion.
   1. Should Engineer determine that the work is not substantially complete:
      a. Engineer will immediately notify Contractor, in writing, stating reasons.
      b. Contractor shall remedy the deficiencies in the Work, send a second written notice of substantial completion to the Engineer.
      c. Engineer will reinspect the Work.
   2. When the Engineer finds that the Work is substantially complete, he will:
      a. Prepare and deliver to the Owner a tentative Certificate of Substantial Completion form 00 65 16 with a tentative list of items to be completed or corrected before final payment.

01 77 16 FINAL COMPLETION 01 77 16

A. When Contractor considers the Work is complete, he shall submit a written certification that:
   1. Contract Documents have been reviewed.
   2. Work has been inspected for compliance with Contract Documents.
   3. Work has been completed in accordance with Contract Documents.
   4. Systems have been tested in presence of Owner.
   5. Work is complete and ready for final inspection.
B. Engineer will make an inspection to verify the status of completion within a reasonable time after receipt of such certification.
C. Should Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies, and send a second written certification to Engineer that the Work is complete.
D. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall request the Contractor to make closeout submittals.
E. Closeout Procedures:
   1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
   2. Provide submittals to Engineer that are required by governing or other authorities and as listed in Section 01-78-00.
   3. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

01 78 00 CLOSEOUT SUBMITTALS 01 78 00

01 78 13 COMPLETION CLOSEOUT DOCUMENTS 01 78 13

A. Certificates:
   1. Evidence of compliance with requirements of governing authorities: Certificates of Inspection.
   2. Evidence of Payment and Release of Liens: Executed Section: 00 65 19 "Contractor's Sworn Statement".
   3. Certificates of Insurance for products and completed operations.
   4. Evidence of Bonding Company approval: Executed section 00 65 20 "Consent of Surety"
B. Final Adjustments of Accounts: Submit a final statement of accounting to Engineer. Statement shall reflect all adjustments to the Contract Price.
   1. The original Contract Price.
   2. Additions and deductions resulting from:
      a) Previous Change Orders.
      b) Unit Prices.
      c) Deductions for liquidated damages.
      d) Other adjustments.
   3. Total Contract Price, as adjusted.
   4. Previous Payments.
   5. Sum remaining due.

The Engineer will prepare final Change Order, reflecting the adjustment to Contract Price not previously made by Change Orders of as-built quantities and all previous Change Orders.

01 78 39 PROJECT RECORD DOCUMENTS 01 78 39

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

D. Record Drawings (and Shop Drawings): Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish (first) (main) floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract Drawings.

E. The Owner shall furnish 1 set of Reproducible Drawings for the Contractor to prepare as-constructed Record Drawings. The Reproducible as-constructed Drawings shall be submitted for review and approval prior to final payment.

F. Submit documents to Engineer with claim for final Application for Payment.

01 78 23 OPERATION AND MAINTENANCE DATA 01 78 23

A. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers.

B Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below, with tab titling clearly printed under reinforced laminated plastic tabs.

D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on 24-pound white paper, in three parts as follows:
   Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   Part 2: Operation and maintenance instructions, arranged by and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for (special) finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Air and water balance reports.
      c. Certificates.
      d. Photocopies of warranties.

E. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of all document sets as required prior to final submission.
F. Submit two sets of revised final volumes, within 10 days after final inspection.

01 78 36 WARRANTIES AND BONDS 01 78 36

Warranties and Bonds: Provide duplicate notarized copies. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers. Provide Table of Contents and assembly in three D side ring binder with durable plastic cover. Submit prior to final Application for Payment. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

Certificate of Substantial Completion

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

This [tentative] [definitive] Certificate of Substantial Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above is hereby declared and is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below.

A [tentative] [revised tentative] [definitive] list of items to be completed or corrected, is attached hereto. This list may not be all-inclusive, and 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 responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as provided in the Contract Documents except as amended as follows:

☐ Amended Responsibilities ☐ Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

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

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

Executed by Engineer Date

Accepted by Contractor Date

Accepted by Owner Date

1.01 SUMMARY

A. Section includes notification submittals and procedure for selective demolition and off-site disposal of material/debris of the Owner's structures as shown on the drawings.
B. Related Requirements: Submittals Section 01 33 00. Permits Section 01 41 00.

1.02 REFERENCES

A. Definitions
1. Remove: Remove and dispose of items shown or scheduled. Discard demolished or removed items .
2. Remove and Reinstall: Remove items shown; clean, service and otherwise prepare them for reuse; store and protect against damage. Reinstall items in same location or in location shown.
3. 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 Owner's designated storage area.
4. Existing to Remain: Protect construction or items shown to remain against damage during selective demolition operations. When permitted by Engineer, Contractor may elect to remove items to suitable, protected storage location during selective demolition and properly clean and reinstall items in their original locations.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate with Owner's continuing occupation/use of the existing structure and with Owner's partial use of completed new work.
B. Scheduling:
1. Schedule: Submit schedule showing proposed methods and sequence of operations for selective demolition work to Owner's representative for review before commencement of Work.
2. Arrange selective demolition schedule so as not to interfere with Owner's on-site operations.
3. Give minimum of 72 hours advance notice to Owner of demolition activities which affect Owner's normal operations and if shutdown of service is necessary during changeover.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Demolition operations shall comply with OSHA and EPA requirements and EPA notification regulations insofar as they apply to demolition work under this Contract.
2. Comply with hauling and disposal regulations of authorities having jurisdiction.
3. If hazardous materials are found during demolition operations, comply with applicable paragraphs of General Conditions.

1.05 SITE CONDITIONS

A. Environmental:
1. Environmental Requirements: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practicable level. Comply with governing regulations relating to environmental protection. Do not use water when it may create hazardous or objectionable conditions including ice, flooding, and pollution.
2. Contractor shall take every precaution to prevent spillage of materials being hauled in public streets.
a. It shall be Contractor's responsibility to immediately clean spillage that may accidentally occur.
b. Do not burn removed material on or within Project Site.

B. Material Ownership:
   1. Demolished materials shall become Contractor's property, except for items or materials shown as Remove and Salvage, or otherwise shown to remain Owner's property. Remove demolished material promptly from Site with further disposition at Contractor's option.
   2. Historical artifacts, relics, and similar objects, including but not limited to cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historical significance remain property of Owner. Notify Owner's Representative when these items are found and obtain method of removal and salvage from Owner.

PART II – PRODUCTS

2.01 REPAIR MATERIALS

A. 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. Provide Owner with samples prior to use.

PART III – EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions:
   1. Before beginning selective demolition work, inspect areas of Work. Survey existing conditions and correlate with requirements shown to determine extent of selective demolition required.
   2. If unanticipated mechanical, electrical, or structural elements conflict with intended function or design, investigate and measure nature and extent of conflicts. Promptly submit detailed written reports to Owner's Representative. Pending receipt of the directive from Owner's Representative, rearrange selective demolition schedule to continue general job progress without delay.

3.02 DEMOLITION

A. Selective Demolition: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

B. Pavement:
   1. Sawcut concrete pavement and curb and gutter a minimum depth of one (1") inch and/or 1/8 depth of concrete pavement. Note pavement panels may be removed. See patching spec.
   2. Sawcut asphalt pavement a minimum of one (1") inch.

C. Explosives or Burning:
   1. Use of explosives or related demolition techniques is prohibited.
   2. Burning of debris/demolished materials is prohibited.

3.03 SITE QUALITY CONTROL

A. The Contractor shall establish and maintain a quality control system for contract requirements and maintain records of its quality control for all operations performed, including, but not limiting to, to following:
   1. Electrical, gas and water disconnection verified.
   2. Dust Control.
   3. Noise and vibration control.

4. Demolition, removal, and cleanup.
5. Disposal.
6. Observance of environmental regulations.

3.04 CLEANING AND WASTE

A. Contractor shall maintain an order of neatness and good housekeeping comparable to that observed by Owner.
   1. Keep tools, scaffolding, and other demolition equipment in neat and orderly arrangement.
   2. Remove dirt and debris resulting from Contractor's demolition operations from Site daily. Dirt and debris shall not collect or interfere with Owner's facility operations.

END OF SECTION

EXISTING CONDITION
SITE DEBRIS DISPOSAL
Section 02-41-14

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the Work consisting of all labor and equipment necessary to handle, transport and dispose of excavated "Site Debris" and all recordation required for the proper disposal of the Site Debris. Disposal shall include all shipping fees, taxes, analytical laboratory fees i.e. all other documentation required by the landfill.

1.02 REFERENCES

A. Definition:
   1. Site debris is non-hazardous material consisting of construction debris, concrete, rock, boulders and/or steel – miscellaneous metal.
   2. Construction debris is wood timber, packing cardboard, plaster and miscellaneous items described on the drawings.

1.03 INFORMATION SUBMITTAL

A. Data:
   1. Submit names of the disposal / "dump' site to be used. Submit names one week before the disposal operation is conducted.
   2. Disposal Documents: Contractor shall provide copies of all manifests, chain of custody, delivery and/or receipts issued for the disposal of site debris.

B. Truck Data:
   1. Submit procedure plan for the removal of site, mud/debris from the truck tires before exiting the site.
   2. Submit truck data for each truck removing debris from the site.
      a. _____mark/designation.
      b. _____ owner
      c. _____/trailer: Box/bed volume struck and heaping.

1.04 SITE CONDITIONS

A. Environmental:
   1. Should debris material, not described, be encountered, consult with Owner's representative.
   2. Maintain designated on-site haul roads in a dust free condition.

B. Existing Condition:
   1. The Engineer and Owner shall be notified immediately when analysis indicate the excavated material is hazardous, as defined by Part III of the Natural Resources and Environmental Act, Acts 451, PA. 1994. The material shall then be disposed of as directed.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

A. Site:
   1. Designate haul routes for debris removal.
   2. Review truck tire cleaning plan.

3.02 LOADING AND HAULING

A. Inspect haul vehicles for soil adhesion to wheels and under carriage. These soils shall be removed and properly handled by the Contractor before leaving site.
   1. No transport vehicles shall be allowed to leave the site which are leaking or spilling materials.
   2. All transport vehicles shall be in strict conformance with all the applicable federal, state and local laws.

B. Truck-loaded volume shall be determined by the Owner's Representative.

3.03 DISPOSAL

A. All disposal shall conform to Federal, State and local government regulations.

B. For non-hazardous contaminated wastes the Contractor shall utilize a State of Michigan approved manifest system so that the waste can be tracked from generation to ultimate disposal. The manifest shall comply with all of the provisions of the transportation and disposal regulations.

3.04 SPILLS

A. The Contractor is responsible for cleaning up all the leaks, spills from containers and other items on site or off site that occur because of the Contractor's negligence. Immediate containment actions shall be taken as necessary to minimize the effect of any spill or leak. The Contractor shall notify the Engineer and appropriate governmental authorities of the incident. Cleanup shall be in accordance with applicable Federal, State, and local laws and regulations.

3.05 CLEANING / CLOSEOUT

A. All haul roads shall be bladed and leveled at project completion.

1.01 SUMMARY

A. This Section includes requirement for the demolition, removal and disposal, off-site, of utility structures, piping and appurtenances at locations shown on drawings.

1.02 REFERENCES

A. Definitions
   1. Remove: Remove and dispose of items shown or scheduled. Discard demolished or removed items.
   2. 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 Owner's designated storage area.
   3. Existing to Remain: Protect construction or items shown to remain against damage during selective demolition operations.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with Owner's continuing operation of the existing system and with Owner's partial use of completed new utility work.
B. Scheduling:
   1. Schedule: Submit schedule showing proposed methods and sequence of operations for selective demolition work to Owner's representative for review before commencement of Work.
   2. Arrange abandon schedule so as not to interfere with Owner's on-site operations.
   3. Give minimum of 72 hours advance notice to Owner of demolition activities which affect Owner's normal operations and if shutdown of service is necessary during changeover.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Demolition operations shall comply with OSHA and EPA requirements and EPA notification regulations insofar as they apply to demolition work under this Contract.
   2. Comply with hauling and disposal regulations of authorities having jurisdiction.
   3. If hazardous materials are found during demolition operations, comply with applicable paragraphs of General Conditions.

1.05 SITE CONDITIONS

A. Environmental:
   1. Environmental Requirements: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practicable level. Comply with governing regulations relating to environmental protection. Do not use water when it may create hazardous or objectionable conditions including ice, flooding, and pollution.
   2. Contractor shall take every precaution to prevent spillage of materials being hauled in public streets.
      a. It shall be Contractor's responsibility to immediately clean spillage that may accidentally occur.
      b. Do not burn removed material on or within Project Site.
B. Material Ownership:
   1. Demolished materials shall become Contractor's property, except for items or materials shown as Remove and Salvage, or otherwise shown to remain Owner's property. Remove demolished material promptly from Site with further disposition at Contractor's option.

2. Historical artifacts, relics, and similar objects, including but not limited to cornerstones and their contents, commemorative plaques and tablets, antiques, and other articles of historical significance remain property of Owner. Notify Owner's Representative when these items are found and obtain method of removal and salvage from Owner.

C. Utility structure shapes are shown on the drawings:
   1. Structure wall probable least dimension.
      a. 12" for masonry or cast-in-place concrete.
      b. 8" for precast concrete.
   2. Pipeline material cast iron, ductile iron or asbestos concrete.

PART II – PRODUCTS

2.01 MATERIALS

A. Materials as shown on drawings or as noted in referenced specification.

PART III – EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions:
   1. Before beginning demolition work, inspect areas of Work. Survey existing conditions and correlate with requirements shown to determine extent of demolition required.
   2. If unanticipated mechanical or structural elements conflict with intended function; Promptly submit detailed written reports to Owner's Representative. Pending receipt of the directive from Owner's Representative, rearrange demolition schedule to continue general job progress without delay.

B. Utility Services: The Contractor shall carefully coordinate the work in this Section with all other work.
   1. Water Disconnection: The Contractor shall 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.
      a. Operation (open/close) of existing value shall be performed by the Owner's staff.

3.02 PREPARATION

A. Utilities:
   1. Drain pipe or remove, collect and dispose of chemicals, gases, explosives, acids, flammable, or other dangerous materials before proceeding with selective demolition operations.

B. Site:
   1. Provide and ensure free and safe passage of Owner's personnel and general public to and from occupied area around demolition areas.
      a. Provide temporary barricades and other forms of protection to protect Owner's personnel and general public from injury.
   2. Remove protection at completion of Work.

3.03 DEMOLITION

A. Demolition: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level.

B. Concrete Masonry
   1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain.
   2. Break up and remove concrete slabs and walls, unless otherwise shown to remain.
   3. Demolish walls to a depth of not less than:

a. 36” below existing roadway surface.
b. 24” below existing ground surface.

4. Break/fracture/crack interior slabs

C. Explosives or Burning:
1. Use of explosives or related demolition techniques is prohibited.
2. Burning of debris/demolished materials is prohibited.

D. Equipment:
1. Piping and valves shall remain in place at Contractor’s option.
2. Valves shall be closed.
3. Piping/Valve shall be removed/demolished to a depth of not less than:
a. 36” below existing roadway surface.
b. 24” below existing ground surface.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes specifications for the filling/plugged/blocking of existing pipelines and structure openings.
B. Related Requirements: Utilities Section 01-18-00.; Common Materials: 31-05-10

1.02 REFERENCES

A. Definitions:
   1. Bulkhead: Vertical Closure/filling of an opening in a wall opening or pipeline.
   2. Tremie: A method of dropping/placing concrete or flowable material through a vertical pipe.
B. Reference Standards
   MDOT- Michigan Department of Transportation Standard Specifications
   ASTM- American Society of Testing Materials, specific 'vol.,,article'

1.03 INFORMATION SUBMITTALS

A. Transit mixed concrete delivery tickets shall show batch weights.

1.04 QUALITY ASSURANCE

A. Coordination: Verify proposed operations with site personnel and pipeline structure owner prior to filling operation.

PART 2 – PRODUCTS

2.01 MATERIAL

A. Brick:
   1. Brick shall conform to the requirements for concrete building brick of ASTM C55, Grade S-II.
      a. Nominal size shall be 2- ¼" x 3-1/2" x 8" in lengths (+/- ¼").
B. Mortar: Mortar for brick laying bedding shall be MDOT type R-2.
   1. Masonry Cement conform to ASTM C 91 Type M.
   2. Masonry Sand shall conform to MDOT Masonry Sand 2MS.
   3. Portland Cement conform to ASTM C-150.
C. Aggregates:
   1. Coarse Aggregate shall conform to MDOT Aggregate 6A.
   2. Fly Ash: ASTM C 618 Class for F .
D. Backfill:
   1. Granular Class II;
   2. Excavated Material- Acceptable

2.02 MIXES

A. Mixes: Approximate bulk unit are as follow:

		Masonry	Hydrated		Aggregate
Type	Cement	Cement	Lime	Fine	Coarse
Mortar	-	1	-	2-1/2	-
Fillet Conc.	1	-	-	1-3/4	2

B. Flowable Fill. A transit mixed blend of Sand, 2MS or 2NS; Portland Cement, type I; and fly ash, class C.
   Mixture: 1: cement; 3-1/2: sand; ½: flyash.

PART 3 – EXECUTION

3.01 PREPARATION

A. Review work area for clearances and site conditions for the pipeline/structure closure. Verify locations of work with site personnel and the structure owner.

3.02 PLUGGING

A. Deposit concrete by tremie method when shown on the drawing.
   1. Place concrete under water in a compact mass, in its final position, by means of a tremie or by pumping. Do not disturb the concrete after deposit.
   2. Support the tremie tube to permit free movement of the discharge and over the entire surface of the work and to permit rapid raising or lowering to adjust the flow of concrete. Always keep the tremie tube in the freshly deposited concrete, withdrawing it only at the completion of each pour.
   3. During placing operations, keep the tremie tube full to the bottom of the hopper. When a batch is dumped into the hopper, induce the flow of concrete by raising the discharge end of the tube slightly, but not out of the concrete.

B. Terminate concrete placement at the elevation shown on the drawings or within two (2) feet above the ground surface.

3.03 PIPELINE FILLING

A. Deposit concrete by tremie method as shown on the drawing.
   1. Allow brick bulkheads to cure, [obtain strength] and or brace faces for the flowable pressures.
   2. Place 'flowable fill,' in its final position, by means of a tremie or by pumping. Do not disturb the concrete after deposit.
      a. leave opening at the opposite end of the pipe line to release "trapped air".
   3. Support the tremie tube to permit free movement of the discharge. Always keep the tremie tube in the freshly deposited concrete, withdrawing it only at the completion of each pour.
   4. During placing operations, keep the tremie tube full to the bottom of the hopper. When a batch is dumped into the hopper, induce the flow of concrete by raising the discharge end of the tube slightly, but not out of the concrete.

B. Terminate concrete placement at the elevation shown on the drawings or within two (2) feet of the ground surface.

END OF SECTION

PART 1 – GENERAL *[Engineer: complete/delete as necessary following: also copy on structural plan sheet]*

STRUCTURAL CONCRETE NOTES

Concrete Joints (03-15-10)

CJ. Construction Joint
EJ. Expansion Joint
SJ. Contraction Joint
IJ. Isolation Joint

Concrete Grades (03-31-00)

Grade	Where

Formwork Surface (03-11-13) art. 2.01

RF:	Rough	03-31-00
SF:	Smooth Finish	03-31-00
Spec:	Special	03-11-16
bf:	both face	
ex:	exposed face	
fs:	fill side face	

Slab Finishes (03-31-00) art. 3.04

F:	Float Finish
TF:	Trowel Finish
NSB:	Non-Slip Broom
CH:	Chemical Hardener

CONCRETE FINISH SCHEDULE

MARK DESIGNATION	FORM FINISH			SLAB FINISH				
Wall / Slab	RF	SF	Spec	F	TF	NSB	CH	Other
W – nn								
S – nn								

ABBREVIATIONS

Abt	about	min	minimum
A.B.	anchor bolt	Sym	symmetrical
@	at	T	thickness
#	bar size (n/8)	typ	typical
cont.	continuous		
d	re-bar diameter		
dwl.	dowel bar		
EW	each way		
exp	exposed		
ext	exterior		

CONCRETE CONSTRUCTION NOTES

1. differences
2. alternates
3. sequence

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section lists requirements and materials for concrete formwork for structural elements.
B. Related Requirements:
   1. Structural Concrete Joints: 03-15-10.

1.02 REFERENCES

A. Reference Standards:
   1. ACI – American Concrete Institute.
   2. ANSI – American National Standards Institute.

1.03 SUBMITTALS

A. Contractor shall submit:
   1. Sequencing form panel for all walls exposed to view.
   2. Placement of contraction (S.J.) and construction (CJ) joint.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Form Facing Material:
   1. Rough Form Finish: RF
      a. Form facing material shall be ANSI A199.1 concrete form plywood, Class II or better, not less than 3/4" in thickness, CC-CD exterior type, mill-oiled and edge sealed, form facing material that will produce concrete surfaces equivalent in smoothness and appearance to that produced by used concrete form plywood panels.
      b. For concrete surfaces exposed only to the ground, form facing materials may be undressed, square edge, 1" nominal thickness lumber.
   2. Smooth Form Finish: SF
      a. Form facing material for formed surfaces to have smooth form finish shall be ANSI A199.1 concrete form plywood, Class I, not less than 5-ply, 1" in thickness, AC-BC exterior high density overlay type 5 ply facing material that is non-reactive with concrete and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.
B. Form Ties:
   1. Form ties shall be factory fabricated, adjustable in length, removable or snap-off metal type, of design that will not allow form deflection nor cause appreciable spalling at the faces of the concrete upon removal; non-fabricated wire ties shall not be used.
   2. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view, except that in no case shall this distance be less than ¾". When the formed face of the concrete is not to be permanently exposed to view, form ties shall be cut off flush with the formed surfaces.
C. Form Coating Compound shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with curing compound.

2.02 FABRICATION

A. Forms shall be constructed to be mortar-tight, strong and rigid to allow placing vibrating and curing of plastic concrete. Form shall be true to lines designated.

B. Smooth Finish Form:
   1. The inside faces of form shall be free of irregularities, holes or unevenness in the surface.
   2. Plywood grain marks shall be in a horizontal direction.

PART 3 – EXECUTION

3.01 PREPARATION

A. General:
   1. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain the tolerances for formed surfaces.

B. Design and Installation of Formwork:
   1. The design and engineering of concrete formwork, as well as its construction shall be the responsibility of the Contractor.
   2. Formwork shall be designed in accordance with ACI Standard 347 for the loads, lateral pressure of wet concrete and unit stresses and other applicable requirements of the controlling local building code.
   3. The form panels shall be arranged to present a uniform geo-metric pattern of formwork/fine. Do not offset or shift form marks.

3.02 FORM INSTALLATION

A. Erection:
   1. Forms:
      a. Forms shall be sufficiently tight to prevent leakage of cement paste during concrete placing.
      b. All exposed joints, edges, and external corners shall be chamfered a minimum of ¾" by moldings placed in the forms.
      c. Temporary openings shall be provided at the base of foundation wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
      d. Forms shall be readily removable without impact, shock or damage to the concrete.
   2. Construction Joints (CJ):
      a. Provide key-ways at least 1-1/2 inch-deep in all construction joints in walls, slabs, and between walls and footings; approved bulkheads designed for the purpose may be used for slabs.
      b. Construction joints shall be perpendicular to the main reinforcement.
   3. Contraction Joint (SJ)
      a. Contract joint insert (03-15-10 art. 3.02C) shall be attached to the formwork, both faces: position of joint insert shall match reduced re-steel locations as further described (03-15-10 art. 3.02A).
      b. Saw cutting of Contraction Joint (S.J.) may be substituted for inserts provided.
         1) forms are removed within thirty-six (36) hours of final concrete placement or;
         2) saw cuts are made with twelve (12) hours of form removal.

B. Form Penetrations:
   1. Embedded Items:
      a. Make provisions for pipes, conduit, sleeves, inserts and other embedded items provided under other Sections and attached to concrete formwork.
   2. Openings for Items Passing Through Concrete:
      a. Frame openings as required for the passage of pipes, ducts, conduit and other work specified under other Sections.
      b. Do not provide any opening larger than 24 inches on any side that is not shown on the Drawings

until written approval for such opening is obtained.

3. Inserts shall be placed in the forms for chamfer edges, wall and expansion joints: contraction joints (S.J.), pipe and drain openings.
4. Control Joints (S.J.)

C. Form Removal: Vertical forms shall remain in place for a minimum of 15 hours after the concrete has been placed. False work and temporary supports shall not be removed until the concrete has obtained seventy (70) percent of the design compressive strength or five (5) days after concrete placement.

D. Tolerances for Formed Surfaces: Formwork shall be constructed so that the concrete surfaces will conform to the following tolerance limits:
1. Variation from plumb: a. In the lines and surfaces of walls.. In any 10' length – ¼"
2. Variation in the sizes and location of openings:… Plus or minus ¼"
3. Variation in thickness of foundation walls and slabs: a. Minus – ¼" b. Plus – ½"
4. Variation in footings:
   a. Variations in dimensions in plan – Minus ½"
   b. Misplacement or eccentricity:
      (1) 2% of the footing width in the direction of misplacement, but not more than 2".
   c. Thickness:
      (1) Decrease in indicated thickness – 5%.
      (2) Increase in indicated thickness – No limit.

3.03 FORM REMOVAL

A. Removing Falsework and Temporary Supports: Leave falsework and temporary supports for concrete structures in place until the concrete at least 70 percent of the specified 28-day design strength, and for at least 5 days following concrete placement.

B. Removing Forms: Do not remove vertical forms, including bulkheads at construction joints, until at least 15 hours after completion of the pour. Remove forms under slab splans, beams, as noted above. If forms are braced against work portions subject to movement due to temperature changes, remove restaining falsework or adjust to prevent damage to the new work.

3.04 LOADING OF SUBSTRUCTURE ELEMENTS

A. Shoring, construction of superstructure elements shall not commence until substructure concrete has obtained 70 percent of the specified design strength.

3.05 CLEANUP

A. Form Tie Holes:
1. Tie holes shall be plugged / patched with "cement repair mortar" (03-31-00 art. 2.02D)

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section discusses types of joints to place in structural concrete: walls, piers, columns, beams, slabs on grade and/or supported slabs.

B. Related Requirements:
   1. Notes & Schedule: 03-06-30.
   2. Concrete Formwork: 03-11-13.
   3. Waterstops Structural Concrete: 03-15-13
   4. 03-99-15 Joint detail shown on drawings (C.J. & S.J.).
   5. 03-99-35 Isolation Joints (slabs).

1.02 REFERENCES

A. Abbreviations:
   1. CJ: Construction Joint.
   2. EJ: Expansion Joint.
   3. SJ: Control Joint (shrinkage joint).
   4. IJ: Isolation Joint (slabs).

B. Reference Standards
   1. ASTM-D994: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
   2. ASTM-D1752: Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.03 ADMINISTRATIVE REQUIREMENTS

A. A meeting shall be scheduled to discuss, and review proposed joint placement for each structural element.

1.04 INFORMATION SUBMITTALS

A. Number of and types of joints to be used for each structural element, shall be submitted.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Expansion Joint Fillers (E.J. & I.J.):
   1. Bituminous Expansion Joint Fillers:
      a. Bituminous expansion joint fillers for expansion joints not to be sealed or caulked.
      b. ASTM D994 preformed bituminous type.
      c. Thickness indicated on the Drawings by width as required to suit conditions of installation.
   2. Sponge Rubber Expansion Joint Fillers:
      a. Furnish sponge rubber expansion joint fillers for expansion joints to be sealed or caulked.
      b. ASTM D1752, Type I, preformed non-extruding and sponge rubber type.
      c. Thickness indicated on the Drawings by width as required to suit conditions of installation.

PART 3 – EXECUTION

3.01 PREPARATION

A. Formwork size and concrete placement procedures shall be reviewed for impacts on the joint positioning set forth below.

B. Joints:

1. Construction Joint (C-J): Construction joints not shown on the Drawings shall be so made and located so as not to impair the strength and appearance of the structure and shall be approved by the Engineer. In general, construction joints shall be located as follows:
   a. In walls, at nor more than 50 ft. in any horizontal direction; and at top of footings.
   b. In piers, at top of footings, columns.
   c. In slabs-on-ground, so as to divide the slab into areas not in excess of 1200 sq. ft.
   d. In floor system at or near middle of span in slabs, beams, or girders unless beam intersects girders at this point.
2. Contraction Joints (S.J.) shall be located as follows:
   a. In walls, in vertically spaced, perpendicular to main reinforcement, not more than 20 feet apart.
   b. In slabs-on-ground: To form panels of patterns as shown.
      If joint pattern is not shown, provide joints at 15 feet at most in either direction, with locations to conform to bay spacing wherever practical (at column centerlines, half-bays, third bays).
3. Provide isolation joints (I.J.) in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces of column pedestals, foundation walls, and grade beams.
4. Expansion Joints shall be located as follows:
   a. In retaining walls not more than 200 feet in length.
   b. In slabs as shown on the Drawings.

3.02 INSTALLATION

A. Reinforcement through:

1. Construction joints (C.J.) shall be continuous across the joints in walls, column piers, and slabs.
2. Control joints (S.J.) (temperature reinforcement) shall be cut 50% through joint in walls.

B. Formed keyway shall be provided in construction joints:

1. Keyway shall be 1-1/2 inch-deep with a width of one-third (1/3) width/thickness of the structural element.
2. Approved bulkhead designed for the purpose may be used for slabs.

C. Contraction Joint (S.J.):

1. Walls: Use ¼ inch x 2-inch inserts or saw cuts.
2. Slab-on-Grade: Use saw cuts 3/16-inch by ¼ slab depth or inserts ¼ inch slab depth.

D. Expansion Joint Fillers Installation:

1. Install expansion joint fillers in vertical and horizontal expansion joints and elsewhere as indicated on the Drawings.
2. Install expansion joint fillers with top flush with concrete finish surface.
3. Where joints are to be sealed or caulked, prior to installing joint fillers, score or perforate the top of the joint filler so that the top can be routed out after installation to provide a joint groove of depth not less than;
   1) joint widths for joints up to ½" wide,
   2) ½" for joints over ½" to 1" wide and,
   3) half width for joints over 1" wide.

E. Bonding:

1. The surfaces of beam, colum, pier and supported slab (2 hours or less) concrete at construction joints shall be roughened, except where bonding is obtained by use of a concrete bond agent, and clean free of laitance coatings, loose particles and foreign matter. Surfaces shall be roughened in a manner which will expose aggregate uniformly and will not leave laitance, loosened particles of aggregate, nor damage concrete at the surface.
2. Bonding of fresh concrete to concrete that has set shall be obtained as follows:
   a. At joints between footings and walls, and elsewhere unless otherwise specified hereinafter, the roughened and cleaned surface of the set concrete shall be dampened, but not saturated, immediately prior to the placing of fresh concrete.
   b. Instead of as specified above, bonding may be obtained by the use of bonding agent. The bonding agent shall be applied to the cleaned concrete surface in accordance with the printed instructions of the bonding agent manufacturer.
3. Bonding of fresh concrete to hardened or existing concrete shall be obtained by use of epoxy bonding adhesive. Store and mix epoxy bonding adhesive materials in accordance with the adhesive manufacturer's printed instructions. Before depositing fresh concrete, the surfaces of the hardened concrete or existing concrete shall be thoroughly roughened and cleaned free of debris and loose concrete, and then thoroughly coated with epoxy bond adhesive not less than 1/16 inch in thickness. Placement of the fresh concrete shall be accomplished while the epoxy bonding adhesive is still tacky and, in such manner, that the bonding adhesive coating will not be removed.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section discusses types of waterstops to be constructed in structural concrete, joints, (walls, slabs on grade).
B. Related Requirements:
   1. Reinforcing Steel: 03-21-00
   2. Concrete Formwork: 03-11-13

1.02 REFERENCES

A. Abbreviations:
   1. CJ: Construction Joint.
   2. EJ: Expansion Joint.
   3. (S.J.): Contraction Joint
   4. WB: Waterstop – Bentonite strip
   5. WP: Waterstop - Panel

B. Reference Standards
   1. USCOE: CRD-C 572
   2. ASTM C55: Standard Specification for Concrete Building Brick.

1.03 ADMINISTRATIVE REQUIREMENTS

A. A meeting shall be scheduled to discuss, and review proposed joint placement for each structural element.

1.04 INFORMATION SUBMITTALS

A. Number of and types of joints to be used for each structural element.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Bentonite Waterstops: (WB)
   1. Waterstop shall consist of 75% sodium bentonite and 25% butyl rubber compound formed into uniform coils. Material shall conform to the requirements of NSF Standard 61.
   2. Waterstop-RX 101T: 1-1/4" x ½" trapezoidal rolls of flexible strip of bentonite and butyl rubber compound with a reinforcing poly scrim for use in concrete construction joints.
   3. Adhesive: Latex and water-based adhesive used to secure all Waterstop-RX products to concrete.
   4. Supplier "Waterstop-RX 101T": Colloid Environmental Technologies Company (CETCO), Arlington Heights, Illinois.
B. Bentonite Panels: (WP)
   1. Panels: Panels consist of 1 lb. (0.45 kg) per square foot of specially treated granular sodium bentonite contained inside a biodegradable, corrugated kraft board measuring 48" x 48" x 3/16" thick and the printed side of the kraft board is treated with a clear, water-resistant coating.
   2. Bentoseal®: Trowel grade sodium bentonite compound used as a detailing mastic around penetrations, corner transitions and grade terminations.
   3. Supplier "Volclay type 1-C": Colloid Environmental Technologies Company (CETCO), Arlington Heights, Illinois.
C. PVC Bulbs Waterstops: (PVC)
   Centerbulb waterstops at expansion joints (E.J.) or construction joints (C.J.) and other joints as shown. Waterstops

shall be PVC conforming to Corps of Engineers CRD-C 572.

1. Type shall be ribbed with center bulb 6" lg. x 3/8": Greenstreak #705, 732 or 973.

D. Expansion Joint Fillers (E.J. & I.J.):

1. Bituminous Expansion Joint Fillers:
   a. Bituminous expansion joint fillers for expansion joints not to be sealed or caulked.
   b. ASTM D994 preformed bituminous type.
   c. Thickness indicated on the Drawings by width as required to suit conditions of installation.

PART 3 – EXECUTION

3.01 PREPARATION

A. Formwork size and concrete placement procedures shall be reviewed for impacts on the joint positioning set forth.

B. Joints:

1. Construct Joint (C-J): Construction joints not shown on the Drawings shall be so made and located so as not to impair the strength and appearance of the structure and shall be approved by the Engineer. In general, construction joints shall be located as follows:
   a. In walls, at nor more than 50 ft. in any horizontal direction; and at top of footings.
   b. In piers, at top of footings, columns.
   c. In slabs-on-ground, so as to divide the slab into areas not in excess of 1200 sq. ft.
   d. In floor system at or near middle of span in slabs, beams, or girders unless beam intersects girders at this point.

3.02 INSTALLATION

A. Expanding Bentonite Waterstops:

1. Fastening Waterstop. Before installing waterstop, apply minimum 15-mil-thick coating of Waterstop-WB adhesive, for width and length of applied expanding bentonite waterstop material, or use mechanical fasteners at no more than 10 inches on center.
2. Verify that 3-inch minimum coverage of concrete placement will occur along waterstop's entire length. Do not install waterstop in keyways.
3. Follow manufacturer's recommended installation procedures.

B. Polyvinylchloride Waterstops: (exp joint)

1 The PVC strip shall be constructed as a continuous one-piece waterstop to produce water tightness. Any required splice shall be in strict accordance with the manufacturer's recommended method.
2. Make all splices by heat sealing adjacent surfaces using a thermostatically controlled electric heat source in accordance with manufacturer's printed instructions.
3. Carefully and correctly position waterstop to form continuous watertight diaphragm in joint to avoid leakage. Support and protect waterstop with ring clips and tie wire tp re-steel.
4. Replace or repair damaged or punctured waterstop as directed by Engineer.
5. Consolidate concrete in vicinity of the waterstop during concrete placement.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes acceptable materials, fabrication of and placement of reinforcing steel of sizes and lengths shown on the drawings.
B. Related Requirements;

1.02 REFERENCES

A. Definitions:
   1. Defective Resteel: Reinforcement which has any of the following defects will not be used in the work:
      a. Bar lengths, depths, and bends beyond the allowable fabrication tolerances.
      b. Bends or kinks not indicated on the Drawings or approved shop drawings.
      c. Bars with reduced cross-section due to rusting or other cause.
B. Reference Standards:
   1. ASTM – American Society of Testing Materials.
   2. ACI – American Concrete Institute.
   3. CRSI – Concrete Reinforcing Steel Institute.

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit shop drawings of concrete reinforcement showing bar sizes and dimensions for fabrication and placing of reinforcement and bar supports. Show bar schedules, stirrup spacing and diagrams of bent bars. Prepare shop drawings in accordance with ACI 315 – *Detailing Manual* and as shown on the drawings.
   2. Note: 50% of horizontal resteel, in walls, may be cut for contraction joint (S.J.) if shown on drawings.
B. Product Data:
   1. Submit data sheets for bar chair supports and; weld splices for reinforcing steel which will act in tension.

1.04 DELIVERY STORAGE

A. Deliver reinforcement to Project site in bundles marked with metal tags, indicating bar size, length, mark, and other information pressed in by machine. Marks shall correspond with those used in the approved shop drawings.
   1. Handle and store reinforcement to prevent corrosion and to keep from ice, grease, and other coatings which would destroy or reduce bond.

PART 2 – MATERIAL

2.01 MATERIALS

A. Reinforcing Bars:
   1. Reinforcing Bars and Stirrups: minimum yield strength 40,000 psi for stirrups and 60,000 psi for reinforcing bars, unless otherwise noted on the Drawings, and conforming to one of the ASTM specifications as listed below:
      a. Deformed Billet-Steel Bars: ASTM A615.
      b. Deformed Rail-Steel Bars: ASTM A996.
      c. Deformed Axle-Steel Bars: ASTM A996.
   2. Welded Wire Fabric: ASTM ASTM A1064.
   3. Tie Wire: Black, annealed steel wire, not less than 16 gauge.
B. Splice Devices: Sized to develop 125% of yield strength of reinforcing bar.

C. Supports for Reinforcement:
   1. General: Bar supports conforming to "Bar Support Specifications" contained in CRSI "Manual of Standard Practice". Provide bolsters, chairs, spacers, and other devices suitable for proper spacing supporting and fastening reinforcing bars and welded wire fabric.
   2. For paving and slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
   3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports protected with plastic or other approved protective coating to prevent rust spots at the exposed surface of the concrete.
   4. For structural concrete footing and slabs, the lower level re-steel must be supported on concrete brick ASTM C-55 gr 5-11 if a mud mat is not provided.

D. Epoxy Coated Reinforcement: Steel reinforcement required to be epoxy coated, as noted on the drawings, shall be coated in accordance to ASTM D 3963;
   1. The coating applicator shall furnish written certification that the coated reinforcing bars were cleaned, coated, and tested according to ASTM 3963.
   2. Bars may be coated before or after bending.

2.02 FABRICATION

A. Shop fabricate reinforcing bars to conform to the shapes and dimensions indicated on the Drawings and in accordance with CRSI "Manual of Standard Practice".

B. Allowable Fabrication Tolerances:
   1. Sheared length – plus or minus 1".
   2. All bends – plus or minus 1".

PART III – EXECUTION

3.01 PREPARATION

A. Preparation:
   1. Surface Condition Reinforcement: All reinforcement at the time concrete is placed shall be free of mud, oil or other material that may adversely affect or reduce the bond. Reinforcement with rust, mill scale or a combination of both, will be accepted as satisfactory without cleaning or brushing provided the dimensions and weights, including heights of deformations, of a cleaned sampled shall be not less than required by the applicable ASTM Specification.
   2. Bending: Reinforcing bars shall not be bent or straightened in a manner that will injure the material. No bars partially embedded in concrete shall be field bent, except as noted on the Drawings or permitted by the Engineer.
   3. Placing Bar Supports:
      a. All reinforcements shall be accurately located in forms or on ground and similar surfaces as applicable to the kind of concrete construction, and securely held in place before and during concrete placing by bar supports adequate to prevent displacement during the course of construction beyond the allowable placement tolerances and to keep all reinforcement at a proper distance from the forms.
      b. Bar supports shall be sufficient in number and sufficient in strength to properly carry the reinforcement they support. When wire bar support units are placed in continuous lines, they shall be so placed that the ends of the supporting wires shall be lapped to lock the last legs on adjoining units. No reinforcing bar shall be placed more than 2" beyond the last leg at the end of a run of any continuous support. Bar supports are not intended to, and shall not be used to, support

runways for concrete conveying equipment and similar construction loads.

c. Bar support spacing and placing sequence shall be as indicated on the approved shop drawings. Reinforcement shall be secured to supports by tie wire.

3.02 INSTALLATION

A. Execution:

1. Spacing of Reinforcing Bars:
   a. The clear space between parallel bars in a layer shall be not less than 1-1/2 times the nominal diameter of the bars or 1-1/2", whichever dimension is the greater. Where parallel reinforcement is placed in two or more layers, the bars in the upper layers shall be placed directly above those in the bottom layer with the clear distance between layers not less than 1-1/2" or 1-1/3 times the maximum size of aggregates, whichever dimension is the greater.
   b. In walls and slabs the principal reinforcement shall be spaced not farther apart than 3 times the wall or slab thickness or 18", whichever dimension is the lesser.
   c. The clear distance limitation between bars shall also apply to the clear distance between a contact lap splice and adjacent splices or bars.
   d. Bars may be moved within the allowable placement tolerances specified under Article 1.02 "Quality Assurance" to avoid interference with other reinforcement, conduits or embedded items. Do not move bars beyond allowable placement.
2. Splices in Reinforcement:
   a. General: Splicing of reinforcing bars shall be by lapping, unless otherwise approved by the Engineer. All splices not shown on the Drawings shall be approved by the Engineer.
   b. Lap Splices:
      1) All lap splices shall be contact type and at the locations indicated on the Drawings. Bar laps shall be securely tie wired together in such a manner as to maintain the alignment of the bars and to provide minimum clearances.
      2) No lap splices in tension shall be permitted without the approval of the Engineer.
      3) Lap splices in compression shall be as specified in ACI 318, *Building Code,* Section 7.7.

B. Wiremesh:

1. Correct bends or kinks in individual wires of welded wire fabric before placing.
2. Overlap welded wire fabric whenever successive mats or rolls are continuous in such a way that the overlap measured between outermost cross wires of each sheet is not less than the spacing of the cross wires plus 2".
3. Secure fabric to bar supports by tie wire.

C. Concrete Protection for Reinforcement:

1. Provide the following minimum concrete cover for reinforcement.
   a. Concrete deposited against ground – 3".
   b. Concrete deposited in forms where concrete surface after removal of forms will be exposed to the weather or liquid or in contact with the ground:
      1) No. 6 bars and larger – 2".
      2) No. 5 bars, 5/8" wire and smaller – 1-1/2".

D. Tolerances:

1. Concrete cover to formed surfaces – plus or minus ¼".
2. Minimum spacing between bars – plus or minus ¼".
3. Top bars in slabs – plus or minus ¼".
4. Lengthwise of members – plus or minus 2".
5. Maximum bar adjustment to avoid interference with other reinforcement or embedded items – one bar diameter.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the materials, concrete grades, and concrete mixes for structural concrete use on this project.
B. Related Requirements:
   1. Formwork: 03-11-13.
   2. Reinforcing Steel: 03-21-00.
   3. Notes and Schedules: 03-06-30.
   4. Structural Concrete Joints: 03-15-10.

1.02 REFERENCES

A. Abbreviations:
   1. EF- degree Fahrenheit; ^{O} F
   2. LBW- loss by washing;
   3. lbs. per cyd- pounds per cubic yard;
   3. sacks- 94 lb bag.
B. Reference Standards
   1. ASTM – American Society of Testing Materials
   2. ACI – American Concrete Institute
   3. MDOT – Michigan Department of Transportation

1.03 ACTION SUBMITTALS

A. Statement of Purchase for Ready-Mixed Concrete: Fifteen 15 days prior to actual delivery of concrete, submit four copies of statement of purchase, giving the dry weights of cement and saturated surface-dry weights of fine and coarse aggregate and quantities, type and name of admixtures (if any), and of water per cubic yard, that will be used for the manufacturer of each concrete class designation. Also furnish evidence satisfactory to the Engineer that the materials to be used and proportions selected will produce concrete of the quality specified. Whatever strengths are obtained, the quantity of cement used shall be not less than the minimum specified.
B. Reports: Submit four copies of reports of each concrete class designation for slump, air content and strength tests as specified in Section 16 of ASTM C94.
C. Ready-Mixed Concrete Delivery Tickets: Submit one copy of each delivery ticket to the Engineer.

1.04 DELIVERY

A. Discharge of concrete shall be completed within 45 minutes, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the aggregates.
   1. In hot weather (air temperature 80EF and above) or under conditions contributing to quick stiffening of the concrete, the discharge time shall be reduced to 30 minutes.
   2. Ready-Mixed Concrete Delivery Tickets: Submit one copy of each delivery ticket to the Engineer indicating the batch weights.

1.05 SITE CONDITIONS

A. Environmental
   1. Concrete delivered in cold weather shall conform to the following temperature limitations for concrete sections.

Site Air Temperature	Minimum Concrete Temperature
30 to 45EF	50EF
20 to 30EF	65EF

2. Concrete delivered in air temperature of 90EF, and above shall have a mix temperature between 60 and 80EF.

PART 2 – MATERIALS

2.01 MATERIAL

A. Aggregates may be Gravel, Stone or Slag meeting MDOT physical requirements and shall conform to the following class and gradations: (3)

	Sieve analysis			Total Percent Passing							Loss by Washing (LBW)
Mark	2in	1.5in	1in	3/4in	1/2in	3/8in	#4	#8	#30	#50	#100	LbW
1. Coarse Aggregates;												
4AA	90-100	40-60	-	0- 12	--	--	--	--	--	--	--	2.0
6AA (1)	----	100	95-100	---	30-60		0-8	--	---	---	--	1.0
6A (2)	----	100	95-100	---	30-60		0-8	--	---	---	--	1.0
2. Fine Aggregate:					3/8in	#4	#8	#16	#30	#50	#100	LbW
2NS	----	--	---	---	100	95-100	65-95	36-75	20-55	10-30	0-10	3.0

3. Notes: (1) sum of soft particles and chert= 4% maximum;
(2) sum of soft particles and chert= 10% maximum;
(3) concrete aggregates for: 'stamped', 'exposed aggregate' walls or walks/slabs shall be Gravel onlv.

B. Cements shall conform to the following:
1. Portland Cement: ASTM – C150 Type I, type II
2. Blended Hydraulic Cement: ASTM – C596 Type IS, [Blast Furnace Slag]
3. ASTM – C596 Type IP, [Pozzolan]

C. Admixtures:
1. Air Entraining Agent: ASTM C260.
2. Fly Ash: ASTM C618, Type C or F.
3. Water Reducing: ASTM C494, Type A.

2.02 MIXES

A. Mixes shall contain the following Blends of Aggregates, Fine Aggregate 2NS, Cements, Water, and Admixtures as follows:

	Concrete Grades			
Mixture Items \	D	S-1	S-2	X
Compressive Strength(psi)				
F'c @28day……..	4500	4000	3500	1500
F'c @ 7day……..	3200	3000		
Minimum Cement Content;				
Lbs .per cyd…….	658	611	564	282
Sks. per cyd……	7	6.5	6	3
Aggregate Type: ….	6AA	6A or 6AA	6AA or 6A	6A
Admixture Types:				
Air Entraining: [4]	6%	6%	6.5%	
Fly Ash……..	[6]	[6]	[5]	
Water Reducing..[7]	[op]		[op]	na
Slump.. inch …..	0-3"		3" max	3"-6"

2.02 MIXES
A. cont'd

Notes: [4].Air entraining agent shall be used in all concrete exposed to weathering.;
[5]….Fly ash admixture may be used as a Type I cement replacement of 20%
[6]….Fly ash admixture may be used as a Type I cement replacement of 15%
[6]….Water-Reducing admixtures may be used in all concrete mixes provided the requirements for: strength, slump, and air content are equal to or greater than concrete grade without an admixture.

B. Concrete Mix Grades shall be used as noted below, unless noted otherwise on the drawings:

Concrete Grade	Concrete Mix useage
D	all structural concrete exposed to weather, and or sanitary sewerage;
S1	structural interior floors, slabs, walls not exposed to weather nor sewerage. pavement, exterior slabs, curb and gutter sections;
S2	underground structures, not exposed to sanitary sewerage.
X	mud mats for trench/base structural slabs in excavations and as noted on the drawings

C. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

D. Cement Repair Mortar:
1. A workable mortar of 1:3 cement blend to 2NS fine aggregate.
2. Blend cement shall be a mixture of 2/3 cement type used in concrete mixture and 1/3 white cement.

2.03 MIXING

A. Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C94, except as otherwise specified in this Section:
1. Ready-mixed concrete shall be mixed and delivered to the point of discharge at the Project site by means of truck-mixed concrete.
2. No water from the truck water systems or elsewhere shall be added after the initial introduction of the mixing water for the batch unless authorized by the Engineer except that under no circumstances shall the approved maximum water content by exceeded nor shall the slump exceed the maximum specified.

2.03 MATERIALS

A. Curing:
1. Water for Curing Concrete: Clean, clear, and free of oil, acid, salt, alkali, organic matter or other deleterious substances.
2. Exterior Membrane-Forming Curing Compound: ASTM C309, Type II.
3. Interior Membrane-Forming Curing Compound: ASTM C309, Type 1-D, Class B, clear or translucent with fugitive dye type.

PART 3 – EXECUTION

3.01 PREPARATION

A. Field measurement:
1. Reinforcement, joint materials and other embedded items shall be secured in position, inspected and approved, before start of concrete placing.
2. All piping and fittings, except drain lines and other piping systems designed for pressures of not more than one pond per square inch above atmospheric pressure, must be tested for leaks by the Trade whose work it

is and approved immediately prior to concreting.

3. Waterstop if shown on drawing, shall be tied into position as shown details.

B. Preparation for Concrete Placement:

1. General:
   a. All surfaces against which concrete is to be placed shall be free of debris, loose materials, standing water, snow, ice and other deleterious substances before the start of concrete placing.
   b. Standing water shall be removed without washing over freshly deposited concrete. Any flow of water shall be diverted through side drains provided for such purpose.
2. Subgrade Under Foundations, Footings and Slabs-on-Ground: The subgrade shall be undisturbed clean surfaces, free of frost, ice, mud and water. When the subgrade material is semi-porous and dry, the subgrade surface shall be sprinkled with water as required to eliminate suction, at the time the concrete is deposited.
3. Formwork: Shall be completed and approved, and hardened concrete, debris and foreign material shall be removed from the interior of forms before the start of concrete placing.
4. Mud mat (x grade concrete) shall be placed, if shown on drawings, to provide a firm base for re-steel support.

3.02 INSTALLATION

A. Conveying Concrete:

1. Transfer of Ready-Mixed Concrete at Project Site: Concrete shall be handled from the point of delivery and transferred to concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials and in a manner which will assure that the required quality of the concrete is maintained.
2. Equipment for Conveying Concrete shall be approved by the Engineer and shall be of a size and design that detectable setting of concrete shall not occur before adjacent concrete is placed. Runways for wheeled concrete conveying equipment shall be provided from the ready-mixed concrete delivery point to the locations of final deposit. Chutes shall be metal or metal lined and shall have a slope not exceeding one vertical to three horizontal; chutes more than 20 feet long may be used provided they discharge into a hopper before distribution. The interior surfaces of concrete conveying equipment shall be maintained free of hardened concrete, debris, water, snow, ice, and other deleterious materials.
3. Pumping:
   a. Upon specific request by the Contractor, and subsequent approval by the Engineer, the concrete may be placed by pumping or pneumatic conveying equipment, subject to the following:
   b. Request for approval must be accompanied by:
      1) Descriptive data of equipment proposed for use in this Project.
      2) Data relative to any modifications to mixes necessitated by proposed system of conveying, including, but not limited to, change in maximum aggregate size, change in aggregate proportions, change in slump, need for particular type of admixture.
   c. At start-up of concrete pumping “water-cement” slurry used to lubricate the piping, shall be discharged outside of the forms.

B. Concrete Placement:

1. Placing Temperature:
   a. When the temperature of the surrounding air is exposed to below 10°F during concrete placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 55°F for sections less than 12 inches in any dimension nor 50°F for any other sections. The temperature of the concrete as placed shall not be as high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90°F.

   b. When the temperature of steel forms and reinforcement is greater than 120°F, such steel surfaces shall be sprayed with water just prior to placing the concrete.

2. Concrete Depositing-in-General: Concrete shall be deposited continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete placing shall be performed at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flow. Concrete which has partly hardened or has been contaminated by foreign materials shall not be deposited, such concrete shall be removed from the work and disposed of in an approved location. Concrete to receive other construction shall be screeded to the proper level to avoid excessive skimming or grouting.
3. Placing Concrete in Forms: Concrete shall be deposited in horizontal layers not deeper than 18 inches in manner to avoid included horizontal layers and inclined construction joints.
    a. All concrete placed in forms shall be consolidated by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. The vibrating equipment shall be at all times adequate in number of units and power of each unit to properly consolidate the concrete. Vibration of forms and reinforcement shall not be permitted.
        1) Vibrators shall not be used to transport concrete inside forms. Vibrators shall be inserted and withdrawn vertically at uniform spaced points not farther apart than the visible effectiveness of the vibrator. Vibrators shall not be inserted into lower courses of concrete that have begun to set.
        2) The placing of concrete in supporting elements shall not be started until the concrete previously placed in columns and walls is no longer plastic.
    b. Concrete placement inside forms shall not fall more than five (5') feet. Concrete dropping more than five (5') feet shall be placed through approved 6 inch diameter pipes.
4. Placing Concrete in Slabs: Concrete shall be deposited and consolidated in a continuous operation, in checkerboard or alternate lane pattern within the limits of approved construction joints until the placing of a panel or section is completed.
    a. During concrete placing operations, the concrete shall be consolidated by mechanical vibrating equipment or other approved method so that the concrete is thoroughly worked around reinforcement and other embedded items. Consolidation operations shall be limited to the time necessary to obtain consolidation of the concrete without bringing to the surface an excess of fine aggregate.
    b. Concrete shall be brought to the correct level with a straight edge, struck off and floated to a smooth surface free of humps and hollows. Finish of slabs shall be as specified hereinafter.
5. Pits and Trenches: Cast pits, trenches and similar construction monolithically wherever possible, of dimensions, shapes and sections shown. If joints are unavoidable, key all joints and provide waterstop in each joint.
6. Equipment Bases:
    a. Furnish and install concrete bases for pumps, fittings, valves and other equipment as indicated on the Drawings and as necessary for a complete installation.
    b. Bases shall be a minimum of 4" above the finished floor elevations, unless otherwise indicated on the Drawings.
    c. Bases shall be smoothly finished and corners rounded.

3.03 PROTECTION

A. Cold Weather Protection: When the temperature of the atmosphere is 40°F and below, the concrete shall be protected by heating, insulation covering, housing or combination thereof as required to maintain the temperature of the concrete at or above 50°F, and in a moist condition continuously for the concrete curing period. Cold weather protection shall meet the requirements of ACI 75-18(306).

B. Hot Weather Protection: When the temperature of the atmosphere is 90°F and above, or during other climate conditions which will cause too rapid drying of the concrete, the concrete shall be protected by windbreaks, shading, fog spraying, light-colored moisture-retaining covering, or a combination thereof as required to maintain the temperature of the concrete below 80°F and in a moist condition continuously for the concrete curing period. Hot

a. Apply chemical-hardeners, three coats, according to manufacturer's printed instructions.
b. After chemical-hardener final coat has dried, remove surplus hardener by scrubbing and mopping with water.

3.05 CURING

A. All concrete surfaces shall be cured by wet curing methods or membrane spray methods. Curing methods shall be implemented after removal of wall form and/or final treatment of flatwork.
1. Membrane curing compound shall not be applied to:
a. Construction joints.
b. Other concrete surface to be bonded by subsequent concrete placement.
c. Steel dowels, anchors, waterstops and similar devices.
d. Interior slab areas which will receive equipment pads.

B. Wet Curing: Wet curing is the placement of burlap on the concrete surface after finishing. Burlap material shall be continuously wet by water from "soaker hose". Time of curing shall be a minimum of three (3) days after end of concrete placement.
1. Where wall forms are not removed within three (3) days and curing compound not applied;
-the top of the concrete wall shall be continuously wetted with "soaker hose".

C. Membrane Curing Compound:
1. Application rates:
a. White pigment: one gallon of compound per 150 sq. ft.
b. Transparent: two applications;
1) one gallon per 300 sq. ft.
2) one gallon per 300 sq. ft. after the first application has dried.

D. Areas to be cured:
1. White pigmented walls both faces:
a. If noted on the drawings, the exterior face may require a special treatment.
b. Exterior slabs, sidewalk curbs and platforms.
2. Transparent compounds:
a. Interior building slabs.
b. Piers or columns.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This section covers the preparation, materials, services, and equipment required for the cleaning on all above grade, vertical, exterior exposed surfaces of masonry, concrete, brick, or stucco.

1.02 RELATED SECTIONS

A. None

1.03 SUBMITTAL

A. Product Specification Data: Submit manufacturer's technical literature, specifications, and application instructions for the specified clear water repellent material.
B. Applicator Qualifications: Submit certification stating applicator has a minimum of three (3) years experience using the specified product. Provide a list of several most recently completed projects where the specified material was used. Include the project name, location, architect and method of application.

1.04 QUALITY ASSURANCE

A. Applicator Qualification: A firm with no less than three (3) years experience in the application of the products specified in this Section. In addition, applicator must state the intended use of the proper application equipment and that it has been well maintained.

B. Mock-Up:
   1. Apply cleaning product per manufacturer's application instructions as directed by the Engineer to substrate material that matches actual job conditions. Determine the acceptability of appearance and optimum coverage rate required for application.
   2. Obtain Engineer and/or Project Owner approval prior to full scale application of cleaning solutions.
   3. Test Panel:
      a. Two (2) locations selected by Engineer/Owner.
      b. Size: 4 ft. x 4 ft.

1.05 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Air and substrate temperature must be above 40°F (4°C) or below 100°F (38°C) unless otherwise specified by manufacturer.
   2. Do not proceed with application if the substrate is wet or contains frozen water.

1.06 SCHEDULING

A. Engineer/Owner shall be notified not less than 48 hours before each application of the cleaning agent is scheduled.

PART 2 – PRODUCTS

2.01 CLEANING AGENT

A. General: All products shall be liquid cleaner used to block, brick, concrete, stone and other porous masonry substrates.

1. Biodegradable Cleaner-Extra Muscle, Great Lake Laboratory.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify the following
   1. Surface to be treated is clean, dry and contains no frozen water.
   2. Environmental conditions are appropriate for application.

3.02 PREPARATION

A. Protection:
   1. Special precautions should be taken to avoid vapor transmission (fumes) from entering the building being treated. Ventilation systems and fresh air intakes should be turned off and closed.
   2. Protect shrubs, metal, wood trim, glass, asphalt and other building hardware during application from over-spray.
   3. Do not permit spray mist or liquid to drift onto surrounding properties or parking lots.

3.03 APPLICATION

A. Apply cleaner by brush, roller, or low-pressure sprayer directly to the "tagged" surface and allow it to dwell for 5 to 8 minutes keeping substrate wet with cleaner. Agitate completely with a nylon scrub brush and rinse thoroughly with water. A power washer (not to exceed 1000 psi) may be required to remove graffiti.
B. In areas that receive multiple "taggings" and if graffiti removal become difficult, a reapplication may be required. If after multiple cleanings, deep-seeded graffiti remains, a more stringent paint remover may be required to completely remove all residual markings.

3.04 CLEANING

A. Remove protective coverings from adjacent surfaces and other protected areas.
B. Immediately clean water repellent coating from adjoining surfaces and surfaces soiled by water-repellent application as work progresses.
C. At completion, remove from the job site, all excess material, debris, and waste resulting from this work. Dispose of water repellent containers according to state and local environmental regulations.

END OF SECTION

SECTION 040140.62

STONE REPOINTING SUMMARY

A. Section includes repointing joints with mortar.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Dort Pumping Station.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.6 QUALITY ASSURANCE

A. Stone Repointing Specialist Qualifications: Engage an experienced stone repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of stone repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide unless otherwise indicated for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Lafarge North America Inc.
b. QUIKRETE.

D. Mortar Cement: ASTM C1329/C1329M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Lafarge North America Inc.

E. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Solomon Colors, Inc.

b. TCC Materials

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part Portland cement, 1 part lime, and 6 parts sand
2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to Portland cement and lime, masonry cement or mortar cement. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to Portland cement and lime, masonry cement or mortar cement. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to stone and store during stone repointing. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/16 inch (1.6 mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose stone, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040140.62

SECTION 040120.64

BRICK MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repointing joints with mortar.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 ALLOWANCES

A. Allowances for repointing brick masonry is:
1. Contractor is to provide for approximately 250’-0” of tuck pointing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Dort Pumping Station.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product provide two (2) sample matching color of existing masonry for approval by architect prior to start of construction.

1.6 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.7 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide, unless otherwise indicated, for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; **gray** where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary, to achieve suitable match.
2. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Solomon Colors, Inc.

b. TCC Materials

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30

minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, **1 part portland cement, 1 part lime, and 6 parts sand**. **Add mortar pigments to produce mortar colors required.**

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks 1/8 inch (3 mm) or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.

2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than **3/8 inch (9 mm)** until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than **3/8 inch (9 mm)**. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.64

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes specification for common masonry material to be used with clay, concrete and glass masonry units.

1.02 REFERENCES

A. Abbreviations:
   1. CMU – Concrete Masonry Unit.
B. Definitions:
C. Reference Standard:
   1. MDOT Michigan Department of Transportation – "Standard Specifications for Construction".
   2. ASTM American Society of Testing Material – "Specific Volume/Article".

1.03 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements:
   1. Mortar Data required consists of the following:
      a. Mortar.
      b. Method of Manufacture (proportion or property).
      c. Material Test Data:
         1) Aggregate for mortar (ASTM C 144 , or MDOT 2ms).
      d. Material Certificate of Compliance.
   2. Grout Data required consists of the following:
      a. Grout Mixes: Include description of type and proportion of grout ingredients.
      b. Material Certificate of Compliance.
   3. Joint Reinforcement, Ties, Anchors, and Flashing:
      a. Manufacturer's Literature.
      b. Material Certificate of Compliance.
B. Samples:
   1. Block - 2
   2. Joint Reinforcement

1.04 QUALITY ASSURANCE

A. Single Source Responsibility
   1. Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
   2. Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.05 DELIVERY STORAGE

A. Deliver masonry materials to Site in undamaged condition.
B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, or other causes. If units become wet, do not place until units are in an air-dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.
D. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.06 SITE CONDITION

A. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and doorframes, as well as similar products with painted and integral finishes from mortar droppings.
B. Cold-Weather Construction - Mortar
   1. Perform the following construction procedures while Work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation.
   2. 40 degrees F to 32 degrees F:
      a. Heat mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
   3. 32 degrees F to 25 degrees F:
      a. Heat mixing water and sand to produce mortar temperatures between 40 degrees F and 120 degrees F; maintain temperature of mortar on boards above freezing.
   4. 25 degrees F to 20 degrees F:
      a. Heat mixing water and sand to produce mortar temperatures between 40 degrees F and 120 degrees F, maintain temperature of mortar on boards above freezing.
      b. Heat both sides of walls under construction using salamanders or other heat sources.
      c. Use windbreaks or enclosures when wind is in excess of 15 miles per hour.
   5. 20 degrees F and below:
      a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 degrees F and 120 degrees F.
      b. Masonry Units: Heat masonry units so that they are above 20 degrees F at time of laying.
      c. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 degrees F for 24 hours after laying units.
C. Cold-Weather Construction – Completed Masonry: Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry temperature ranges apply to anticipated minimum night temperatures.
   1. 40 degrees F to 32 degrees F
      a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistant membrane.
   2. 32 degrees F to 25 degrees F cover masonry with weather-resistant membrane for at least 24 hours.
   3. 25 degrees F to 20 degrees F
      a. Completely cover masonry with weather-resistant insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.

   4. 20 degrees F (-7 degrees C) and below:
      a. Except as otherwise indicated, maintain masonry temperature above 32 degrees F (0 degree C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 degrees F for 48 hours.
D. Hot-Weather Construction: When the ambient air temperature exceeds 100 degrees F, or 90 degrees F with a wind velocity greater than 8 miles per hour, do not spread mortar beds more than 4 feet ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 – PRODUCTS

2.01 MATERIALS

A Mortar and Grout:
1. Compressive Strength: 3,000 psi.
2. Portland Cement: ASTM C150, Types I or II; except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
3. Masonry Cement: ASTM C 91:
   a. For colored pigmented mortars use pre-mixed colored masonry cements of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Match existing. Field verify.
4. Aggregate for Mortar: ASTM C 144 with the following exceptions:
   b. For joints less than ¼-inch use aggregate graded with 100 percent passing the No. 16 sieve.
   c. Colored Mortar Aggregates: Ground marble, granite, or other sound stone, as required to match Engineer's sample. Match existing. Field verify.
5. Aggregate for Grout: ASTM C 404.
6. Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars. Match existing. Field verify.
7. Water: Clean and potable.

B. Joint Reinforcement:
1. Provide joint reinforcement complying with requirements of referenced unit masonry standard and this article, formed from the following:
   a. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire, and with ASTM A 153, Class B-2 (1.5-ounce per square foot of wire surface) for zinc coating applied after pre-fabrication into units.
      1) Application: Exterior and interior walls.
2. Description: Welded-wire units pre-fabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with pre-fabricated corner and tee units, and complying with requirements indicated below:
   a. Wire Diameter for Side Rods: 0.1483-inch (9-gauge).
   b. Wire Diameter for Cross Rods: 0.1483-inch (9-gauge).
   c. For single-wythe masonry provide type as follows with single pair of side rods:
      1) Ladder design with perpendicular cross rods spaced not more than 16 inches o.c. and number of side rods as follows:
3. For multi-wythe masonry provide type as follows:
   a. Ladder design with perpendicular cross rods spaced not more than 16 inches o.c. and number of side rods as follows:

      1) Number of Side Rods for Multi-wythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches in nominal width plus one side rod for each wythe of masonry 4 inches or less in nominal width.

C. Ties and Anchors:
1. Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this Paragraph.

a. Zinc-Coated (Galvanized) Steel Sheet: Carbon steel with zinc coating complying with ASTM A 653, Coating Designation G90.
b. Hot-Dip Galvanized Carbon Steel Sheet: ASTM A 1008, Class 2, or ASTM A 635; hot-dip galvanized after fabrication to comply with ASTM A 153; Class B.

2. Steel Plates and Bars: ASTM A 36, hot-dip galvanized to comply with ASTM A 123 or ASTM A 153, Class B3, as applicable to size and form indicated.

D. Adjustable Anchors for Connecting Masonry to Structural Framework:
1. Two-piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.
2. For anchorage to concrete framework, provide manufacturer's standard with dovetail anchor section formed from sheet metal and triangular-shaped wire tie section sized to extend within 1 inch of masonry face and as follows:
a. Channel-Slots and Ties: 11-gauge steel, hot-dip galvanized.

E. Rigid Anchors:
1. Provide straps of form and length indicated, fabricated from metal strips of following width and thickness.
a. 1-1/2 inches wide by 1/4-inch thick.
b. As indicated.

F. Miscellaneous Anchors:
1. Unit Type Masonry Inserts in Concrete: Cast iron or malleable iron inserts of type and size indicated.
2. Anchor Bolts: Steel bolts complying with A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C, of diameter and length indicated and in the following configurations:
a. Headed bolts.
b. Non-headed bolts, straight.

G. Post-Installed Anchors: Anchors as described below with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.
1. Type: Expansion anchors.
2. Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts and nuts; Alloy 304 or 316 for anchor.
3. Cast-in-Place and Post-Installed Anchors in Concrete: Capability to sustain, without failure, a load equal to 4 times loads imposed by masonry.
4. Post-Installed Anchors in Grouted Concrete Masonry Units: Capability to sustain, without failure, a load equal to 6 times loads imposed by masonry.

H. Miscellaneous Masonry Accessories:
1. Mortar Net: Provide mortar net made of high-density polyethylene (HDPE) or nylon stands woven into a 90 percent open-mesh, formed into dovetail shape to break up mortar droppings and prevent mortar damming. Mortar net shall be non-reactive with common building materials, non-absorbent, shall not support mold or fungus growth, and shall be inedible to insects.
2. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
a. Plastic Rectangular Weep Hole: Clear Butyrate 3/8-inch-wide by 1-1/2-inch-high by 2-1/2-inch-deep tube.

2.02 MORTAR AND GROUT MIXES

A. Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellant agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification for job-mixed mortar and ASTM C 1142 for ready-mixed mortar, of types indicated below:

1. Limit cementitious materials in mortar to Portland/masonry cement.
2. For masonry, use Type S.

C. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Match existing. Field verify.

D. Colored Aggregate Mortar: Produce mortar of color required by use of colored aggregates in combination with selected cementitious materials.
1. Mix to match Engineer's sample.

2.03 QUALITY CONTROL

A. Concrete Masonry Unit Tests: For each type, class, and grade of concrete masonry unit indicated, units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content per ASTM C 140.

PART 3 – EXECUTION

3.01 PREPARATION

A. Examination:
1. Examine conditions, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.
2. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.
3. Do not proceed until unsatisfactory conditions have been corrected.

B Preparation:
1. Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions, and directions as required for installation.
2. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.
3. No masonry shall be supported on wood girders or other form of wood construction.
4. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry with existing masonry.

3.02 INSTALLATION

A. General:
1. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
2. When vertical reinforcement is called for, mortar face shell and web of cores containing grout and reinforcing bars.

3. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses. Masonry directly above chases or recesses wider than 12 inches shall be supported on lintels.
4. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

B. Laying Masonry Walls:
1. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-

size units at corners, jambs, and where possible at other locations.

2. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
3. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   a. One-half running bond with vertical joint in each course centered on units in courses above and below.
4. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
5. Stopping and Resuming Work: In each course, rack back one-half unit length for one-half running bond or one-third unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.
6. Built-In Work: As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
   a. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
      1) At exterior frames insert extruded polystyrene board insulation around perimeter of frame in thickness indicated but not less than ¾-inch to act as a thermal break between frame and masonry.
   b. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
   c. Fill cores in hollow concrete masonry units with grout three courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

C. Bedding and Jointing:
1. Lay solid brick-size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
2. No Furrowing Allowed: Mortar shall be spread and beveled into a battered pyramid formation. Peak of formation shall be at a position approximately two-thirds the distance from back of brick to the exterior face, as recommended by MIM.
3. Lay hollow concrete masonry units as follows:
   a. With full mortar coverage on horizontal and vertical face shells.
4. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
5. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
6. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

D. Horizontal Joint Reinforcement:
1. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8-inch on exterior side of walls; ½-inch elsewhere. Lap reinforcing a minimum of 6 inches.
2. Space continuous horizontal reinforcement as follows:
   a. For multi-wythe walls (solid or cavity) where continuous horizontal reinforcement acts as structural bond or tie between withes, space reinforcement as required by code but not more than 16 inch o.c. vertically.
   b. For single-wythe walls, space reinforcement at 16-inch o.c. vertically, unless otherwise indicated.
   c. For parapets, space reinforcement at 8-inch o.c. vertically, unless otherwise indicated.

3. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8 inches apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints.
4. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
5. Provide continuity at corners and wall intersections by use of prefabricated L- and T-sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

E. Vertical Core Reinforcement:
1. Install vertical reinforcement in cores as shown on drawings.
   a. Lap vertical resteel.
   b. Install dowel bars from vertical core to horizontal bond beam.

F. Anchoring Masonry to Structural Members:
1. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
   a. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
   b. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
   c. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

G. Movement (Control and Expansion) Joints:
1. Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
2. Form control joints in concrete masonry as follows:
   a. Fit bond breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.

3. Form expansion joints in brick made from clay or shale as follows:
   a. Build flanges of factory-fabricated expansion joint units into masonry.
   b. Build in joint fillers where indicated.
   c. Form open joint of width indicated but not less than 3/8-inch for installation of sealant and backer rod specified in Section 07900. Maintain joint free and clear of mortar.
4. Build in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting nonmetallic 50 percent compressible joint filler of width required to permit installation of sealant and backer rod specified in Section 07900.
   a. Locate horizontal pressure-relieving joints beneath lintels supporting masonry.

H. Lintels:
1. Install steel lintels above all masonry openings; size of steel lintel shall be per Lintel Schedule.
   a. Provide 4-inch bearing for all openings less than 4 feet. For openings greater than 4 feet, provide one inch of bearing for each foot of span.

I. Construction Tolerances:
1. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arises, do not exceed ¼-inch in 10 feet, or 3/8-inch in a story height not to exceed 20 feet, nor ½-inch in 40 feet or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/8-inch in any story or 20 feet maximum, or ¼-inch in 40 feet or more. For vertical alignment of head joints do not exceed plus or minus ¼-inch in 10 feet, 3/8-inch maximum.
2. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed ¼-inch in any bay or 20 feet maximum, nor ½-inch in 40 feet or more. For top surface of bearing walls do not exceed 1/8-inch between adjacent floor elements in 10 feet or 1/16-inch within width of a single unit.

3. Variation of Linear Building Line: For position shown in plain and related portion of columns, walls, and partitions, do not exceed 3/8-inch in any bay or 20 feet maximum, nor ¾-inch in 40 feet or more.
4. Variations in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 3/8-inch. Do not exceed head joint thickness indicated by more than plus or minus 1/8-inch.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes listing and methods of CMU construction.
B. Related Requirements
   1. Common Works for Masonry 04-05-00
   2. Miscellaneous Fabrications 05-58-00

1.02 REFERENCES

A. Reference Standards:
   1. MDOT Michigan Department of Transportation – "Standard Specifications for Construction".
   2. ASTM American Society of Testing Material – "Specific Volume/Article".

1.03 INFORMATION SUBMITTALS

A. Product Data:

1.04 SITE CONDITIONS

A. Environmental normal ambient temperatures at the Facility range from zero 0 degF to 115 degF.
B. Cold Weather Conditions; see 04-05-00art. 1.06B.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Concrete Masonry Units: Comply with requirements indicated below applicable to each form of concrete masonry unit required.
   1. Provide two-core, plain-end units for walls vertically reinforced.
   2. Provide special shapes where indicated and as follows:
      a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
      b. Bullnose units for outside corners of interior work only unless otherwise indicated.
   3. Concrete Block: Provide units complying with characteristics indicated below for grade, face size, exposed face and, under each form included, for weight classification.
      a. Normal Weight Units: Normal weight units shall be used for exterior walls below grade and exterior units of single- and multi-wythe walls above grade. Units shall be Grade N, manufactured from normal weight aggregates conforming to ASTM C 90.
      b. Medium Weight Units: Medium weight units shall be used for interior walls and interior wythe of exterior walls above grade. Units shall be Grade S, manufactured from lightweight expanded or sintered blast furnace slag, clay, shale or slate conforming to ASTM C 90.
   4. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.
      a. Concrete Masonry Units: Manufactured to specified dimensions of 3/8-inch less than nominal widths by nominal heights by nominal lengths indicated on Drawings.
   5. Provide Cured Units: Manufacturer must store units outside after manufacture a minimum of 30 days under a covered storage area to protect the units from additional moisture during the curing (drying) process.
   6. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
B. Hollow Load-Bearing Concrete Masonry Units: ASTM C 90, Grade N, and as follows:

1. Unit Compressive Strength: Provide units with minimum average net area compressive strength indicated below:
   a. 3,000 psi.
2. Weight Classification:
   a. Medium Weight: (105-125 PCF Concrete).
   b. Normal Weight: (>125 PCF Concrete).

C. Solid Load-Bearing Concrete Masonry Units: ASTM C 90, Grade N, and as follows:
1. Unit Compressive Strength: Provide units with minimum average net area compressive strength indicated below:
   a. 3,000 psi.

2.02 MIXES

A. Reference: 04-05-00

PART 3 – EXECUTION

3.01 PREPARATION

A. Reference: 04-05-00

3.02 INSTALLATION

A. Execution:
1. Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.
2. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction.
   a. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   b. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
   c. Do not remove forms and shore until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
3. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8-inch joints.
   a. Where solid CMU units are shown, lay with full mortar head and bed joints.
4. Reinforcement:
   a. Lap All Splices in horizontal and vertical reinforcing bars at least 48 bar-diameters unless otherwise required by governing building code.
   b. Reinforcing Bars shall have a minimum clear spacing from inside face of masonry core of a minimum of one-inch.
   c. Clean reinforcement loose rust, mill scale, earth, ice, or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on Drawings or final Shop Drawings, or bars with reduced cross-section due to excessive rusting or other causes.
   d. Position reinforcing accurately at the spacing indicated. Support secure vertical bars against

displacement. Horizontal reinforcing shall be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1 inch (whichever is greater).

e. Field Adjustments: If it is necessary to move bars to avoid interference with other reinforcing steel, conduits, or embedded items, and bars are moved more than one bar-diameter, or enough to exceed the specified tolerances. Architect/Engineer shall be notified and the resulting arrangement of bars shall be subject to acceptance.

5. Walls:
   a. Pattern Bond: Lay CMU wall units in one-half running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
   b. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
   c. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
   d. Grout fill cores of block wall two courses below each bond beam supporting roof, floor, and other structural members. Place metal lath under lowest block to be grouted to confine grout pour.
   e. Install two No.5 vertical bars on each side of all masonry openings extending from 1 inch below lintel bearing point to 2'-0" below the bottom of the window opening unless otherwise indicated on structural Drawings.
6. Block Core Walls:
   a. Place vertical re-steel and lap as shown.
   b. Place CMU on through vertical reinforcement.
7. Columns, Piers, and Pilasters:
   a. Use CMU units of the size, shape, and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown.
   b. Provide pattern bond shown or, if not shown, alternate head joints in vertical alignment.
   c. Provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater. Provide lateral ties as indicated.
   d. Where bonded pilaster construction is shown, lay wall and pilaster units together to maximum pour height specified.
8. Grouting:
   a. Use "Fine Grout" per ASTM C 476 for filling spaces less than 4 inches in one or both horizontal directions.
   b. Use "Coarse Grout" per ASTM C 476 for filling 4-inch spaces or larger in both horizontal directions.
   c. Grouting Technique: At Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow.
9. Low-Lift Grouting:
   a. Provide minimum clear dimension of 2 inches and clear area of 8-square-inch in vertical cores to be grouted.

   b. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar-

diameters or 10 feet.

c. Lay CMU to maximum pour height. Do not exceed 5-foot height, or if bond beam occurs below 5-foot height, stop pour at course below bond beam.

d. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2 inches below top course of pour.

e. Bond Beams: Stop grout in vertical cells 1-1/2 inches below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

3.03 CLEANING & TOLERANCES

A. Repair Pointing:

1. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.
2. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.
3. Construction Tolerances: see 04-05-00 art.3.02I
   a. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arises, do not exceed

B. Cleaning:

1. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   a. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   b. Test cleaning methods on sample wall panel; leave one-half panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
   c. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   d. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
   e. Clean brick by means of bucket and brush hand-cleaning method described in BIA, "Technical Note No. 20 Revised," using the following masonry cleaner:
2. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.
3. Protection: Provide final protection and maintain conditions in a manner acceptable to installer that ensures unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes processes for "Hot-Dip Galvanizing" of iron and steel after fabrication.
B. Related Section:
   1. 05-nn-nn Metals.
   2. As noted on the drawings.

1.02 REFERENCES

A. Abbreviations:
   1. American Society of Testing Material.
   2. American Galvanizers Association.
   3. Structured Steel, Painting Council.
   4. American Welding Society.
B. Reference:
   1. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
      ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      ASTM A384: Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
      ASTM A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
      ASTM A767: Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

1.03 INFORMATION SUBMITTALS

A. Submit a certificate of compliance stating that hot dip galvanized coatings meets or exceeds the specified requirements of ASTM A 123, ASTM A 767 or ASTM A 153 as applicable and complies with other requirement's specified herein.

1.04 QUALITY ASSURANCE

A Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following the procedures of the Quality Assurance Manual of the American Galvanizers Association.

1.04 DELIVERY STORAGE

A. Load and store galvanized articles in accordance with accepted industry standards to prevent the formation of wet storage stain.
   1. Load material in such a manner that continuous drainage may occur.
   2. Store articles raised off the ground and, if necessary, separated with strip spacers to provide free access of air to most parts of the surface. Incline units in a manner which will permit continuous drainage.
   3. Do not support galvanized steel on cinders or clinkers.
   4. Do not support galvanized steel on wet soil or decaying vegetation.
B. Handle articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

PART 2 - PRODUCTS

2.01 APPLICATORS

A. Acceptable Coating Applicators:
   1. Voight & Schweitzer, Detroit, MI., 313-535-2600.
   2. Monroe Michigan
   2. Trinity Highway Galvanizers, Lima OH, 419-227-1296.
   3. Members of the American Galvanizers Association.

2.02 MATERIALS

A. Steel material for galvanizing shall be structural shapes, pipe, sheet, fabrications and assemblies geometrically suitable for galvanizing as described in ASTM A 384.
B. Zinc for Galvanizing: Conform to ASTM B 6. The composition of metal in the galvanizing bath shall not be less than 98% zinc.
C. Galvanizing Repair Paint: Inorganic zinc-rich primer; one of the following:
   1. SSPC-Paint 20, Type 1.
   2. SSPC-Paint 30.
   3. Series 66, Tnemec

2.03 FABRICATION / ASSEMBLIES

A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's "Recommended Details for Galvanized Structures."
B. Fabricate products in accordance with the applicable portions of ASTM A 143, ASTM A 384, except as specified herein. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
C. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
D. Provide holes and/or lifting lugs to facilitate handling during galvanizing.
E. Remove, by blast cleaning or other methods, surface contaminants and coatings that would not be removable by the normal chemical process in the galvanizing operation.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Pre-clean steel work in accordance with accepted methods to produce an acceptable surface for quality hot-dip galvanizing.
   1. Prepare steel utilizing a caustic bath, acid pickle, and flux. Where appropriate, steel may be blast cleaned and fluxed.

3.02 COATING

A. Application:
   1. Galvanize steel members, fabrications and assemblies after fabrication by the hot-dip process in accordance with ASTM A 123.
      a. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A 153 in a kettle capable of reaching 1000 degrees Fahrenheit.
      b. Galvanize reinforcing steel in accordance with ASTM A 767.

2. Use of the “wet method” process of galvanizing, involving a flux blanket on the kettle is prohibited.
3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filling off smooth.

B. Requirements:
1. Coating Weight: Conform with paragraph 5.1 of ASTM A 123, Table 1 of ASTM A 767, or Table 1 of ASTM A 153, as appropriate.
2. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
3. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

3.03 WELDING

A. Perform welding of galvanized steel in accordance with the publication D19.0, Welding Zinc Coated Steel.

3.04 INSPECTIONS & TESTS

A. Inspect and test hot-dip galvanized coatings at the galvanizers plant under the guidelines in the AGA publication “Inspection of Products Hot-Dip Galvanized After Fabrication.” Inspections and tests shall include the following:
1. Visual examination and tests in accordance with ASTM-A 123, A 767 or A 153 as applicable to determine the thickness of the zinc coating on the metal surface.

B. Where slip factors are required to enable friction grip bolting, obtain these after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the Specification for Structural Joints Using ASTM F3125

3.05 REPAIR OF DAMAGED COATING

A. The maximum area to be repaired is defined in accordance with ASTM A 123 Section 6.2 current edition. Surfaces to be repaired shall be clean, dry, and free of oil, grease and corrosion products.

B. Repair uncoated areas and areas damaged by welding, flame cutting or during handling, transport or erection by one of the following methods in accordance with ASTM A 780 whenever damage exceeds 3/16 inch in dimension. Minimum thickness requirements for the repair are described in ASTM A 123 section 6.2.3.
1. Repair using Zinc-Based Alloys: Comply with requirements in Annex A in ASTM A 780.
2. Repair Using Paints Containing Zinc Dust: Comply with requirements in Annex A2 in ASTM A 780.
   a. The use of aerosol (spray) cans is prohibited. Use brush applied paint products for touch up of galvanized surfaces.
3. Repair Using Sprayed Zinc (Metallizing): Comply with requirements in Annex A3 in ASTM A 780.

C. Wet Storage Stain: Remove wet storage stain as follows prior to installation to prevent premature failure of the coating:
1. Arrange objects to allow rapid surface drying.
2. Remove light deposits with a stiff bristle (not wire) brush. Remove heavier deposits by brushing with an acidic based metal cleaner. Thoroughly rinse cleaned surfaces with water.

D. Repair using Zinc Rich paints;
1. Damaged/non galvanized areas power tool to whit4e metal SSPC spec SP-11;
2. Apply two coats of ’90-97 Tnemec Zinc’ paint.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements for ferrous metal connection and anchors.
B. Related Sections:
   1. 05-nn-nn
   2. 40-nn-nn
   3. other

1.02 REFERENCES

A. Abbreviations:
   1. American Society of Testing Material.
   2. American Welding Society.
   3. American Society of Mechanical Engineers.
   4. American Institute of Steel Construction.
B. Definitions:
   1. Corrosive atmosphere.
   2. Site Exterior.
   3. Building/Structure:
      a. heated
      b. unheated
   4. Underground Structures: Valve, meter pits.
C. Reference:
   1. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
      ASTM A320: Standard Specification for Alloy-Steel and Stainless Bolting for Low-Temperature Service
      ASTM F3125: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
      ASTM A449: Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
      ASTM F3125: Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
      ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts
      ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
      ASTM F436: Standard Specification for Hardened Steel Washers
      ASTM F1554: Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
      ASTM F2329: Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
   2. ASME B1.1 Standard Specification for Unified Screw Threads
      ASME B18.2.6: Standard Specification for Fasteners for Use in Structural Applications

PART 2 - PRODUCTS

2.01 DESIGN

A. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, Coarse Thread Series, Class 2 Fit, unless otherwise specified.

B. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. Nut dimensions shall conform to ANSI Standard B18.2.2 for heavy hex nuts.

C. Allowable tensile design stress for threaded fasteners shall not be greater than 0.33 times minimum tensile strength of threaded fastener on tensile stress area.

D. Concrete Fasteners: When the size, length and load carrying capacity of concrete fasteners is not specified or shown on the Drawings, provide the size, length and capacity required to satisfy all of the following. Concrete fasteners include anchor bolts, expansion anchors, or concrete inserts:
   1. Working load shall be a minimum of the design load times a safety factor of four, and shall be based on a concrete compressive strength not exceeding 3000 psi.
   2. Shall satisfy all minimum recommendations and requirements of Manufacturer.
   3. Allowances for vibration are not included in the safety factor specified above.

E. Determine design loads as follows:
   1. For equipment anchors, use the design load recommended by the manufacturer and approved by the Engineer.
   2. For pipe hangers and supports, use one half the total weight of pipe, fittings, valves, accessories and water contained in pipe, between the hanger or support in question and adjacent hangers and supports on both sides. Load shall be increased where required to allow for thrust and temperature induced forces.

F. Anchors and inserts shall be located and sized so as not to impair the integrity of the supporting structure.

2.02 MATERIALS

A. Anchor Bolts, nut and washers:

1.	Imbedded		ASTM
	a.	Corrosive	A320 alloy 316 / F593
	b.	Site Exterior	A320 alloy 316 or A307 gal.
	c.	Building	A307
	d.	Structural Steel	
	e.	Underground	
2.	Drilled-in-place		
	a.	Wedge / expansion	
	b.	Epoxy injected capsule	
	c.	Suppliers	

B. Bolting Fastening:

1.	Atmosphere / Location:		
	a.	Corrosive	
	b.	Site Exterior	
	c.	Building	
	d.	Structural Steel	
	e.	Underground	
2.	Dissemble Metals:		
	a.	Aluminum	ASTM 320

2.03 MATERIALS

A. Bolts and Anchor Bolts (Excluding Pipe Joints):
   1. Galvanized Steel Bolts and Nuts: Steel anchor bolts, studs, nuts and washers for interior installation shall be in conformity with the current ASTM Designation: A307 "Carbon Steel Bolts and Studs, 60,000 PSI

Tensile Strength", Grade B, A36 or approved equal. All steel bolts, studs, nuts and washers shall be hot-dip galvanized in conformance with Class C of ASTM A153. Nuts shall conform to requirements of ASTM A563, heavy hex style.

2. Stainless Steel Bolts and Nuts:
   a. Where specified, in buried, outdoor, high humidity or submerged locations, provide stainless steel bolts, nuts and washers. Stainless steel bolts, anchor bolts, and nuts shall have a minimum yield strength of 30 KSI and be in conformity with the current ASTM A276 and ASTM A320, (AISI Type 304), or approved equal.
   b. Bolts, washers and nuts submerged within the basins shall be stainless steel type 304 unless noted otherwise on the drawings.
   c. For high strength applications, stainless steel bolts and nuts shall be in conformity with the Specified minimum yield strength as indicated on Drawings.
3. Other types, if shown on drawings on drawings or specified under other Sections. Submerged bolting materials within the rapid mixing basins shall be Hasterolly C or fiberglass as required.

B. Pipe Joints for Ductile Iron Pipe:
   1. Galvanized Bolts and Nuts (For EXPOSED Piping Installations):
      a. Steel anchor bolts, flange bolts, studs and nuts shall be in conformity with the current ASTM A307 "Carbon Steel Bolts and Studs, 60,000 PSI Tensile Stength", Grade B or approved equal.
      b. All steel bolts, studs and nuts, shall be hot-dip galvanized in accordance with ASTM A153.
      c. At joint harnesses and restrained harnesses connected to flange, the tie bolts and studs, flange bolts and nuts shall conform to ASTM A354 Grade BC or ASTM A193 Grade B7 (115/125 KSI Min. Tensile Strength for 4" diameter and under). Lug and ring shall be ASTM A36 steel.
      d. All steel bolts, studs and nuts, shall be hot-dip galvanized in accordance with ASTM A153.
   2. Stainless Steel Bolts and Nuts (Where Specified):
      a. Stainless steel flange bolts and nuts shall have a minimum yield strength of 50 KSI and be in conformity with the current ASTM A276 and ASTM A320, (AISI Type 304) or approved equal.
      b. Stainless steel bolts and nuts for harnesses flanges and connecting restrained harnesses to flange shall be in conformity with the Specified minimum yield strength as indicated on Drawings.
      c. Bolts, washers and nuts submerged within basins shall be stainless steel type 304 unless noted otherwise on the Drawings.
   3. Corrosion resistant steel (CRS) (For BURIED Piping Installations and inside manholes): A325, 436, 563 or 490, 436 & 563)
      a. CRS anchor bolts, flange bolts, studs and nuts shall be "Cor-Ten" type, and also in conformity with the ASTM: A242 "High Strength Low-Alloy Structural Steel" Type 1, A588 "High Strength Low-Alloy Structural Steel With 50 KSI Minimum Yield Point" Grade A, or approved equal.
      b. At buried mechanical joints, bolts and nuts shall be in conformity with all of AWWA C111 dimensions and requirements.
      c. Above specified bolts and nuts shall be tension tested for a minimum ultimate tensile stress of 65 ksi using testing procedures corresponding to ASTM A307 requirements and shall be proof load tested based on 45 ksi stress to AWWA C111 standards.
      d. Bolt heads shall be marked with manufacturer, ASTM material designation/grade, and country where manufactured. Markings shall be raised or depressed.
      e. At buried joint harnesses and restrained harnesses connected to flange, the tie bolts and studs, flange bolts and nuts shall be "Cor-Ten" type steel in conformity with the current ASTM: A325, "Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength", Type 3.
   4. Bolt strength shall be adequate to provide compression needed for water tightness of the gasket material used.

C. Expansion Anchors:
   1. Expansion Anchors shall be single cone wedge type or multiple cone wedge type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Anchor Bolting:
   1. Slab and wall surface: Embedded and drilled-in-place.
   2. Slab or beam edges: Embedded or epoxy injected.
B. According to Manufacturer Instruction

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes materials and fabrication and installation methods for metal embedded access hatches. Access hatches shall be as shown on the drawings.

1.02 REFERENCES

A. American Society of Testing Material - ASTM.
B. American Institute of Steel Construction – AISC.
C. American Welding Society – AWS.
D. Building Code.

1.03 ACTION SUBMITTALS

A. Product Data: Provide loading criteria, anchor bolt fixture, details of product descriptions, product limitations. Provide cut sheets for hatches and castings.

1.04 QUALITY ASSURANCE

A. Conform to AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", latest edition and governing Local or State Codes.
B. Fabricate structural steel members in accordance with AISC Code of Standard Practice.
   1. Perform Work in accordance with AISC Section 10.

1.05 SITE CONDITIONS

A. Verify that field measurements are as indicated on shop drawings. Projects requiring alterations of existing structures it is mandatory that new openings and framing required be field measured.

PART 2 – PRODUCTS

2.01 FERROUS METALS

A. Materials shall conform to the following:
   1. Steel Section: ASTM A36.
   2. Steel Plates, Shapes & Bars: ASTM A283.
   3. Pipe: ASTM A53, Gr B.
B. Hardware:
   1. Bolts and nuts shall conform to the following:
      a. Shop framing: ASTM A307.
      b. Field Connection: ASTM F3125, bolts; ASTM-A563 nuts; F436 washers.
   2. Stainless steel bolts and nuts when called for on the drawings shall conform to ASTM A320. Gr. B8M.
C. Finishes:
   1. Shop prime paint compatible with finish field paints specified 09-00-???
   2. Galvanized when called for on the drawings shall conform to:
      a. Iron and steel hardware, nuts, bolts, washers: ASTM A153.
      b. Fabricated and non-fabricated plates, bars, and sections: ASTM-A123 – 2 oz./sq. ft.

2.02 NON-FERROUS METAL

A. Aluminum shall be 6161-T6 and conform to:
   1. Plates: ASTM B209.
   2. Extrusions: ASTM B221.

B. Bolts for aluminum fabricated items be stainless steel ASTM A320.

2.03 FABRICATED ITEMS

A. Design:
   1. Cover: Shall be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span or;
   2. Shall be reinforced to support a minimum live load of 300 psf with a maximum deflection of 1/150th of the span.
   3. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   4. Operation of the cover shall not be affected by temperature.
   5. All access hatches shall be gasketed.

B. Components:
   1. Cover: Shall be ¼" steel diamond pattern; shall be single leaf or double leaf as shown on the drawings.
   2. Frame: Channel frame shall be ¼" steel with full anchor flange around the perimeter.
   3. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.
   4. Drain coupling: Provide a 1-1/2" (38mm) drain coupling located in the right front corner of the channel frame.
   5. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed ¼" gusset support plate.
   6. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.
   7. Hardware:
      a. Hinges: Heavy forged brass hinges, each having a minimum 3/8" (9.5mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
      b. Cover shall be equipped with a hold open arm that automatically locks the cover in the open position.
      c. Cover shall be fitted with the required number and size of compression spring operators. Springs shall have an electrocoated acrylic finish.
      d. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
      e. Hardware: Compression spring tubes shall be an anti-corrosive composite, all fasteners shall be Type 316 stainless steel material, and all other hardware shall be zinc plated and chromate sealed. Springs shall have electrocoated acrylic finish for corrosion resistance. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].

8. Hinged “safety grate” shall be aluminum, with SS hardware epoxy-polyester coating orange color.

C. Supplier: Hatches shall be pre-assembled by:
1. Bilco Company – New Haven CT
2. East Jordan Iron Works, East Jordan, MI.
3. Halliday Products, Inc.

PART 3 – EXECUTION

3.01 PREPARATION

A. Preparation:
1. Coordinate and furnish anchorages, setting drawings and templates.
2. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

3.02 EXECUTION

A. Erection:
1. Provide temporary bracing or anchors in formwork for items that are built into concrete masonry or similar construction.
2. Install 1-1/2” diameter piping from the channel drain as shown on the drawings.

3.03 CLEANING AND ADJUSTING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for tough-up of field painted surfaces.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes materials and fabrication requirements for miscellaneous metal fabrications and appurtenances.
B. Related Requirements:
   1. Galvanizing 05-05-43

1.02 REFERENCES

A. American Society of Testing Material - ASTM
B. American Institute of Steel Construction – AISC – 303-16
C. American Welding Society – AWS – AISC – Manual of Steel Construction
D. Building Code
E. National Association of Chain Manufacturers –NACM

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Indicate profiles, sizes, spacing, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   2. Connections, fittings, clips, seats, bearing plates, stiffeners, splice material, high tensile bolts, unfinished bolts, anchors, etc.
   3. Loads.
   4. Indicate welded connections with AWS A2.0 welding symbols. Indicate net weld lengths.
B. Product Data: Provide high strength bolt test data, anchor bolt fixture, details of product descriptions, product limitations. Provide cut sheets for hatches and castings.

1.04 QUALITY ASSURANCE

A. Conform to AISC "Code of Standard Practice – for Steel Buildings and Bridge", latest and governing Local or State Codes.
   1. Section 3 Design Documents and Specifications – option 2 shall control.
B. Fabricate structural steel members in accordance with AISC Code of Standard Practice.

1.05 SITE CONDITIONS

A. Verify that field measurements are as indicated on shop drawings. Projects requiring alterations of existing structures it is mandatory that new openings and framing required be field measured.

PART 2 – PRODUCTS

2.01 FERROUS METALS

A. Materials shall conform to the following:
   1. Steel Section: ASTM A36: "C", "L" & "S"
   2. Steel Plates: ASTM A992: "W"
   3. Pipe: ASTM A53, Gr B.
   4. Headed rod anchor similar to "Nelson" stud H4L.
   5. Chain:
      a. Carbon Steel: Carbon 0.35% max.; Phosphorous 0.035% max; sulfur, 0.04% max.

b. Alloy Steel: Carbon Steel Plus: Nickel (0.40% min.) and at least one of the following elements must be present in an alloying amount: Chromium (0.40% min.) or Molybdenum (0.15% min.).

B. Hardware:
1. Bolts and nuts shall conform to the following:
a. Shop framing: ASTM A307.
b. Field Connection: ASTM F3125, bolts; ASTM-A563 nuts; F436 washers.
2. Stainless steel bolts and nuts when called for on the drawings shall conform to ASTM A320. Gr. B8M.
3. Anchor Studs shall be:
a. Headed rod anchor or
b. 1" x 3/8 x 0'-8 bent plate.

C. Finishes:
1. Shop prime paint compatible with finish field paints specified 09-00-???
2. Galvanized when called for on the drawings shall conform to:
a. Iron and steel hardware, nuts, bolts, washers: ASTM A153.
b. Fabricated and non-fabricated plates, bars, and sections: ASTM-A123 – 2 oz./sq. ft.

2.02 NON-FERROUS METAL

A. Aluminum shall be 6161-T6 and conform to:
1. Plates: ASTM B209.
2. Extrusions: ASTM B221.
3. Pipe: .

B. Bolts for aluminum fabricated items be stainless steel ASTM A320.

2.03 FABRICATION

A. Assembly:
1. Fit and shop assemble in largest practical sections, for delivery to site.
2. Fabricate items with joints tightly fitted and secured.
a. Continuously seal joined members exposed to weather, by continuous watertight welds, ground smooth.

B. Punching and Drilling:
1. All holes for high strength bolts and unfinished bolts shall be accurately spaced and shall have a diameter 1/16 inch greater than the nominal diameter of the unit.
2. Holes for passage of pipes and conduits shall be drilled and reinforced as necessary, upon prior written approval of the Owner. Holes shall not be burned out.

C. Welding – Cutting:
1. Grind exposed welds and joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
2. No shop or field burning is permitted without the permission of the Owner. If permission is given, all burned members shall be finished to an acceptable appearance which shall be the equal of a sheared finish.

D. Bolting:
1. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
2. Bolt heads, where required, shall be countersunk flush with the surface of the members in which they are located.
3. Structural shop connections shall be welded or bolted with high tensile bolts. Initial shop bolting when used shall be for erection purposes only.
4. Final torque all shop and field bolted connections in the field to provide unit connections.
5. All bolted connections shall be made with not less than two, ¾ inch minimum diameter, high strength bolts.

2.04 FABRICATED ITEMS

A. Rough Hardware: Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Fabricate items to sizes, shapes and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Guard Posts: Fabricate pipe bollards from Schedule 80 steel pipe. Fabricate sleeves for bollard anchorage from steel pipe with ¼" thick steel plated welded to bottom of sleeve./ rerod per detail..???

C. Chain:

1. Chain shall be "size and grade" or "working load (WL) and grade" shown on the drawing.

2. Chain shall be welded heat treated steel in accordance with the NACM "Welded Steel Chain" Specification. Welded Steel Chain "grade" and use as follow:

Grade	Steel	Use
100 or 80	Alloy	-overhead lifting
70	Carbon	-transport, load securement
43	Carbon	-construct agriculture lumbering
30	Carbon	-general purpose

   a. Grade of chain shall be embossed on links, every 3 feet.
   b. Carbon steel chain (Gr 70, 43, or 30) shall not be used for direct overhead lifting applications.

3. Link connectors shall match chain size and shall be type as follow:
   a. "Double clevis link" – grade 70 and 43 chain.
   b. "Connecting link" – grade 3 or chain only.
   c. "Coupling link" – grade 80, 100 chain.

D. Loose Steel Lintels: Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining member together to form a single unit where indicated. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings unless otherwise indicated. Galvanize loose steel lintels located in exterior walls.

E. Pipe Bollards: Fabricate pipe bollards from Schedule 80 steel pipe. Fabricate sleeves for bollard anchorage from steel pipe with ¼" thick steel plated welded to bottom of sleeve./ rerod per detail..???

F. Guard Chains: Provide 3/16" nickel-chrome link construction guard chains where indicated on the Drawings. Supply chains with snap-type fasteners at each end to permit attachment to standard eyelets. Do not paint chains.

G. Anchors:

1. Provide anchor bolts that are the products of Wej-It Corp., Red Head Flush, Phillips Drill Co., or by reviewed equivalent manufacturer. For anchoring to concrete and solid masonry materials, use mild steel wedge anchors with nuts and bolts suited to the item requiring attachment. Unless indicated to the contrary on the Drawings, use heavy head hex nuts and washers for structural anchoring. For specific applications of anchoring to solid masonry, lag shields and/or lead caulking anchors may be substituted for wedge anchors if prior review is given by the ENGINEER. For anchoring to drywall, plaster, paneling, hollow masonry and similar surfaces, use toggle bolt or expanding hollow wall anchors.
2. Install all anchors in strict accordance with manufacturer's recommendations.

H. Shelf Angles: Fabricate shelf angles from steel angles with anchors, shapes of size indicated on the drawing to walls

and floor slabs at locations indicated. Weld adjoining member together to form a single unit where indicated.

2.05 QUALITY CONTROL

A. Unless otherwise shown, field connections shall be made with not less than ¾" diameter high strength bolts.
B. Where connections are not detailed on the Drawings, the connection shall be selected from AISC Manual of steel Construction, Part 4, Framed Beam connections to support not less than the reaction of the uniform load capacity of each particular beam or girder in relation to its size and span. In addition, the connection, whether bolted or welded, shall in no case be less than ½ of the maximum shear capacity of the member and the welds of welded connections shall be spread over not less than ½ of the depth of the member.
C. Connections of tension members or tensile splices shall develop the forces based on the net cross section, unless otherwise noted.
D. Connections of compression members and compression splices shall be designed under consideration of the governing slenderness ratio. Compression splices shall be placed only at or near places of lateral support.
E. Flexural splices shall develop the section modules of the spliced member unless otherwise noted.

PART 3 – EXECUTION

3.01 PREPARATION

A. Field Measurements:
   1. Building/structure rehabilitation projects will require field measurements.
B. Preparation:
   1. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
   2. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.
   3. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

3.02 INSTALLATION

A. Erection:
   1. Provide temporary bracing or anchors in formwork for items that are built into concrete masonry or similar construction.
   2. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. 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.
B. Fastening:
   1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
   2. Unless otherwise noted, high strength bolts shall be governed by the current specifications for structural

joints using current ASTM F3125 bolts, A563 nuts, and F436 washers (as approved by the Research Council for Riveted and Bolted Structural Joints).

3. All joints shall be designed and executed as bearing type connections with threads excluded from the shear plane.
4. Tightening: High strength bolts shall be tightened by calibrated wrenches or by the "Turn of the Nut" method.

C. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, method used in correcting welding work, and the following:
   1. Use material and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

D. Fabricated Items:
   1. Setting Loose Plates/Self Angles:
      a. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
      b. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
      c. Use metallic nonshrink grout in concealed locations where not to be exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 CLEANING AND ADJUSTING

A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for tough-up of field painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9, Section "Painting" of these specifications.

END OF SECTION

SECTION 061053

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring and grounds.
5. Wood sleepers.
6. Utility shelving.
7. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following: Retain first subparagraph below if Project includes wood adjacent to roofing or waterproofing.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841Retain option in first paragraph below if required for plywood backing panels.

B. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.

4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.

B. Other Framing: Construction or No. 2 grade of any of the following species:

1. Hem-fir (north); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.
4. Southern pine or mixed southern pine; SPIB.
5. Spruce-pine-fir; NLGA.
6. Douglas fir-south; WWPA.
7. Hem-fir; WCLIB or WWPA.
8. Douglas fir-larch (north); NLGA.
9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Utility Shelving: Lumber with 15 percent maximum moisture content of eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterlinggrade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Eastern softwoods, No. 2 Common grade; NELMA.
3. Northern species, No. 2 Common grade; NLGA.
4. Western woods, construction or No. 2 Common grade; WCLIB or WWPA.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer. Retain "Flexible Flashing" Paragraph below if required as a separator between preservative-treated wood and metal decking.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, Butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Do not splice structural members between supports unless otherwise indicated.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements for material, fabrication and installation of "structural" Fiberglass Reinforced Plastic assemblies:
   1. Ladders in cages.
   2. Stairs and stair treads.
   3. Handrails and appurtenances.
   4. Grating.
   5. Structural shapes for platforms/walkways shown on drawings.

1.02 REFERENCES

A. Abbreviations:
   1. FRP – Fiberglass Reinforced Plastic.
   2. OSHA – Occupation Safety and Health Act.
   3. CFR – Compiled Federal Regulations.
   4. lb = pound, 1bf = pound per lineal feet, psf = pounds per square feet.
B. Reference Standards: OSHA – 29 CFR.

1.03 ACTION SUBMITTALS

A. Shop Drawing submittals shall include:
   1. Drawings showing fabrication and installation of FRP Assemblies, including plans, elevations, sections, details of components, and attachments to other units of Work.
   2. Product Data for each type of product specified.

1.04 INFORMATION SUBMITTALS

A. Submit specific design loading criteria used in the sizing of specific assemblies.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain FRP material and Assemblies of each type and from a single manufacturer.
   1. Seasafe Inc. Lafayette, La;
   2. Fibergrate Composite Structure, Stephenville, Texas.
B. Engineering Responsibility: Engineer FRP Assemblies by qualified Professional Engineer legally authorized to practice in jurisdiction where Project is located.

1.06 DELIVERY STORAGE

A. Handle all FRP with reasonable care to prevent damage. Use shipping pallets to move material. Do not drag FRP material.
B. FRP Assemblies shall be stored to prevent twisting, bending, breaking, or damage of any kind. FRP Assemblies stored outside shall be covered to prevent exposure to sunlight.

1.07 SITE CONDITIONS

A. Existing Condition – Field Measurements: Where handrails and railings are indicated to fit to other construction, Contractor shall obtain actual dimensions of other construction by accurate field measurements before fabrication.

PART 2 – PRODUCTS

2.01 ASSEMBLY DESIGN

A. Products:
1. Grating 100 psf uniform level load with deflection not exceeding 1/4", 0.25 inch.
2. Structural Shapes: Live and deadloads from platforms and walkways. Deflection shall not exceed LD of 180. Liveload for platforms and walkways shall be 100 psi unless noted otherwise on the drawings.

B. Assemblies:
1. Ladders and cages.
2. Stairs and stair treads: Design liveload shall be 1000 lb per s.f. of tread areas. Additionally, stair treads shall be designed to support a 300 lb. concentrated load at the center point of each tread. Stair landings shall be designed to support a 1000 lb. concentrated load.
3. Handrails and appurtenances: Handrail system shall be designed to withstand a 1000 lb. concentrated load (vertical or horizontal) at any point on the top rail.

2.02 MATERIALS

A. All FRP materials, excluding grating, shall be manufactured with either Isophthalic-Polyester or Vinylester resins.
1. FRP material for floor grating shall be with Vinylester.
2. All structural shapes shall be constructed of strand roving, transverse mat, and a synthetic surface veil. Including ultraviolet (UV) light inhibitors.
3. All structural shapes shall be flame retardant per ASTM E-84 Class 1 Flame Spread of less than 25.
4. After fabrication of FRP, all cuts, holes, and abrasion shall be sealed to prevent corrosion.

B. Anchorage:
1. Grating clips shall be stainless steel 316.
2. Anchor Bolts:
a. expansion type
b. expoy type

2.03 ASSEMBLY FABRICATION

A. Ladders:
1. Ladder rails shall be 2 x 2 x ¼ square tube. Ladder rungs shall be 1 inch diameter solid round.
2. Ladders and cages are to be safety yellow.
3. Ladder rungs are to penetrate inside wall of ladder rail tube and be countersunk into outside wall of ladder rail tube, providing support for the ladder rung in 4 places. This connection is to be fully bonded and with epoxy adhesives and pinned to prevent rung rotation.
4. Ladder rungs to have slip-resistant quartz epoxy grit surface.
5. Ladder stand-off brackets are to be FRP and are to be installed at a maximum of 6'-0 on center. Ladder base mount brackets are to be FRP. All bolts are to be 316 stainless steel.
6. Ladder cages, if required per OSHA, shall be fabricated from FRP Hoops and Straps. FRP Hoops are to be 3 x ¼ preformed FRP. Hoop spacing shall be a max. of 4'-0 on center. FRP Straps are to be 2 x ¼ FRP and are to be spaced at 9" on center. Hoops and Straps are to be bonded with epoxy adhesives and riveted with 316 stainless steel rivets.

B. Stairs and stair treads:
1. Graing to be (select corresponding thickness from catalog) thick with a grid pattern of (select corresponding grid pattern from catalog).

2. All molded grating shall have ultraviolet (UV) inhibitors.
3. Grating and Stair Treads shall have integral embedded grit for slip resistance.
4. Stair Treads shall have 1-3/4" safety yellow integral bull nosing.
5. All platform grating shall be attached with 316 stainless steel grating clips. Minimum of 4 clips per piece.

C. Handrails:
1. Handrail posts and rail shall be 2 x 2 x ¼ square tube. All posts and rails shall use the same tube size. All tubing for handrail to have a minimum ¼" wall thickness.
2. All handrail to be safety yellow and spacing shall be 6'-0" center to center.
3. All post to rail connection to be fully bonded with an epoxy adhesive and shall have a 1-1/2" square solid internal connection plug for added strength and durability. All connections to have a smooth transition between post and rail.
4. FRP handrail to standard 2-rail design unless noted otherwise.
5. Kick plates shall be provided at handrail locations adjacent to all openings.

D. Grating:
1. Floor grating opening shall be 1 inch by 4 inch maximum.
2. Bearing has depth shall be 1 inch minimum.
3. Fabricated panel width shall be 3 feet minimum.
4. Floor grating panels shall be furnished with embedded angle frames.
   a. Angle frame angles shall be sized to match the grating panel depths. Frame angles shall also have attached intergral anchors.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting installation and performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.03 INSTALLATION

A. General:
1. Installation procedures shall be in compliance with printed instructions as furnished by the manufacturer.
2. All field cuts, holes, and/or abrasion shall be sealed with sealing resin, furnished by the FRP fabrication.

B. Assembly Anchorage:
1. Floor grating "angle frames" shall pre-set in concrete floor slabs.
2. Anchor Bolts shall be stainless steel.
   a. Bolts may be expansion or embedded epoxy type.
   b. Bolts for anchorage located less than four (4") inches from the edge of concrete slabs shall be embedded epoxy type.

C. Assembly Installation: Set FRP fabrication assemblies accurately in accordance with supplies shop drawings and installation instructions.
1. Install in location and elevation with edges and surfaces, level, plumb true as measured from established lines and levels.
   a. Handrail and ladders shall be free of rock.
   b. Floor grating that have pipe openings through the grating panel shall be field bonded.

3.04 ADJUSTING

A. Repair damaged or defective finish materials where possible to eliminate functional or visual defects. Where not possible to repair or replace.

3.05 CLEANING

A. Clean finish exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.06 PROTECTION

A. Provide protection and maintain conditions that eliminate damage at time of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section covers the preparation, materials, services, and equipment required in conjunction with the application of a clear water repellent on all above grade, vertical, exterior exposed surfaces of masonry, or brick.

1.02 RELATED SECTIONS

A. Section 04 20 00 Unit Masonry

B. Section 04 01 00 Maintenance of Masonry

C. Section 09 91 00 Painting

D. Section 09 97 23 Concrete and Masonry Coatings

1.03 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Specification Data: Submit manufacturer's technical literature, specifications, and application instructions for the specified clear water repellent material.

C. Samples: Obtain liquid samples of the specified clear water repellent for sample application. Sample application is covered in section 1.04 QUALITY ASSURANCE.

D. Applicator Qualifications: Submit certification stating applicator has a minimum of three (3) years experience using the specified product. Provide a list of several most recently completed projects where the specified material was used. Include the project name, location, architect and method of application.

1.04 QUALITY ASSURANCE

A. Manufacturer: A firm with no less than ten (10) years experience in manufacturing the products specified in this section.

B. Applicator Qualification: A firm with no less than three (3) years experience in the application of the products specified in this section. In addition, applicator must state the intended use of the proper application equipment and that it has been well maintained.

C. Mock-Up:
   1. Apply water repellent per manufacturer's application instructions as directed by the Architect to substrate material that matches actual job conditions. Determine the acceptability of appearance and optimum coverage rate required for application.
   2. After sample treatment has cured in accordance with manufacturers recommendations, water test to verify that substrate is coated with sufficient water repellent to effectively repel liquid water from the surface.
   3 Obtain Engineer and/or Owner approval prior to full scale application of water repellents.
   4 Test Panel.
      a. One [1] location selected by Engineer/Owner.
      b. Size 2 ft. x 2 ft.

D. Pre-Application Meeting: Convene a pre-application meeting prior to the start of application of the specified material.

1.05 PRODUCT DELIVERY

A. Material Delivery: Deliver materials to the job site in original sealed containers, clearly marked with manufacturer's name, brand name, and type of material. Verify the product matches that of the original sample applied on the mock - up wall.

B. Record Keeping: Contractor / applicator shall record product batch number or lot number for warranty purposes.

C. Storage & Protection: Store materials inside if possible, away from sparks and open flame. Store in a secure area to avoid tampering and contamination. Water based materials must be kept from freezing. Store and handle in accordance with manufactures written instructions.

1.06 PROJECT CONDITIONS

A. Surface Preparation: Surface must be free of cracks, dirt, oils, paint or other contaminants which may effect the appearance or performance of the water repellent material.

B. Environmental Requirements:
1. Air and substrate temperature must be above 40° F (4° C) or below 100° F (38° C) unless otherwise specified by manufacturer.
2. Do not proceed with application if the substrate is wet or contains frozen water.
3. Do not apply material when rain is predicted within 24 hours; or earlier that five (5) days after the substrate became wet.
4. Do not apply materials in high or gusty winds.

C. Protection:
1. Special precautions should be taken to avoid vapor transmission (fumes) from entering the building being treated. Ventilation systems and fresh air intakes should be turned off and closed.
2. Protect shrubs, metal, wood trim, glass, asphalt and other building hardware during application from over-spray.
3. Do not permit spray mist or liquid to drift onto surrounding properties.

1.07 SCHEDULING

A. Engineer shall be notified not less that 48 hours before each application of water repellent is scheduled.

1.08 WARRANTY

A. The Contractor shall provide a warranty against water intrusion through above grade concrete and masonry surfaces for a period of one (1) year from the date of application. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints or cracks in excess of 1/16 inch, fire, vandalism, or abuse by maintenance equipment.

1.09 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

1. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E-96.
2. Water Penetration and Leakage through masonry: No dampness or water leakage of wall after 4 hours of water exposure, per ASTM E-514.
3. Durability: No sign of deterioration after 4000 hours exposure, per ASTM C 795

PART 2 - PRODUCTS

2.01 WATER REPELLENT

A. GENERAL: All products shall be solvent based, RTV Silicone Rubber with less than 700 grams per liter VOC. All products shall contain a minimum of 15 percent solids.

1. Tnemec / Chemprobe - Dur A Pell GS Series 626 Solvent based 15% solids RTV Silicone Rubber Water Repellent and Graffiti Protection System. 800/760-6776

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify the following – New Masonry:
1. The required joint sealants have been installed.
2. New masonry and mortar has cured a minimum of twenty-eight (28) days.
3. Surface to be treated is clean, dry and contains no frozen water.
4. Environmental conditions are appropriate for application.

3.02 PREPARATION

A. Protection:
1. Special precautions should be taken to avoid vapor transmission (fumes) from entering the building being treated. Ventilation systems and fresh air intakes should be turned off and closed.
2. Protect shrubs, metal, wood trim, glass, asphalt and other building hardware during application from over-spray.
3. Do not permit spray mist or liquid to drift onto surrounding properties or parking lots.

B. Other:
1. Verify lawn sprinklers are turned off, where applicable, so as to avoid water contact prior to cure times required by the manufacturer.

3.03 APPLICATION

A. Apply specified water repellent in accordance with manufacturer's written application instructions.

1.	CMU	65-85	Sq.Ft./Gal.
2.	Brick	125-150	Sq.Ft./Gal.
3.	Concrete	200-300	Sq.Ft./Gal.

B. Material must be applied using solvent resistant, low-pressure application equipment designed for water repellent application.

C. Apply material as shipped by the manufacturer. Do not dilute or thin.

D. Apply using a low-pressure sprayer with a fan tip that allows for an application pressure of 20 to 40 psi. Apply first coat in a saturating spray application from bottom up. Apply sufficient material to create a 4” to 6” rundown below the contact point. Caution should be used on dense substrates to not over-apply. On dense substrates, minimal rundown is required to avoid over application. Backroll all areas that appear to be fully saturated. A second coat shall be applied once first coat appears dry (30 minutes to 2 hours) depending on temperatures and substrate. All coats should be examined for areas of over application and such areas should be brushed or backrolled to avoid excessive film build and unsightly darkening.

3.04 FIELD QUALITY CONTROL

A. The Engineer shall be contacted 48 hours prior to application so as to provide supervision as required. The architect or the architect's representative shall inspect the progress as the work proceeds. Do not apply any water repellent that is not specified by the architect.
B. After water repellent has cured for five (5) days at low humidity and temperature between 70°-90° F or eight (8) days at high humidity and low temperature between 50°-69° F, all surfaces shall be tested with a light water spray. Recoat any area that indicates water absorption after the water test has completely dried.

3.05 CLEANING

A. Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent coating from adjoining surfaces and surfaces soiled by water-repellent application as work progresses.

C. At completion, remove from the job site, all excess material, debris, and waste resulting from this work. Dispose of water repellent containers according to state and local environmental regulations.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes listing of materials for Insulation of building spaces and slabs on grade as shown on drawings.
B. Related Requirements:
   1. Insulation under slabs-on-grade.
   2. Foundation wall insulation (supporting backfill).
   3. Cavity wall and masonry cell insulation.

1.02 REFERENCES

A. Abbreviations;
   CMU. Concrete Masonry Unit
B. Reference Standard:
   1. ASTM C549 Standard Specification for Perlite Loose Fill Insulation, dust suppression, inorganic insulation, loose fill, perlite, thermal insulation.
   2. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing, blanket, corrosion, light frame.
   3. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

1.03 ACTION SUBMITTALS

A. Product data: Submit manufacturer's product literature and installation instructions for each type of insulation and vapor retarder material required.
B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

1.03 QUALITY ASSURANCE *

A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by R-values they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in reference material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Surface Burning Characteristics: ASTM E 84.
   2. Fire Resistance Ratings: ASTM E 119.
   3. Combustion Characteristics: ASTM E 136.

1.04 DELIVERY STORAGE *

A. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation
B. Protection for Plastic Insulation:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 – PRODUCTS

2.01 MATERIALS *

A. Polystyrene Board Insulation
1. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
a. Type IV, 1.60 lb/cu. ft., unless otherwise indicated; compressive resistance of 25 psi per ASTM D 1621.
b. Aged thermal resistance (R-value) per inch of thickness at 5 years: 5 deg F x h x sq. ft./Btu at 75 deg F.
c. Water Absorption: Maximum 0.1 percent by volume per ASTM C 272.
d. Edge Profile: Square.
e. Basis of Design Product: Dow Chemical Co. “Styrofoam®”.
2. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
a. Thickness: 1/8 inch, nominal, for vertical applications; ¼ inch, nominal, elsewhere.
3. Manufacturers:
a. DiversiFoam Products.
b. Dow Chemical Company.
c. Owens Corning.

B. Glass-Fiber Blanket Insulation:
1. ASTM C 665, of type indicated below; critical radiant flux of 0.11 Btu/sq ft or greater.
a. Unfaced, Type I (blankets without membrane facing); with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
1) Basis of Design Product: Johns Manville Unfaced Batts.
b. Faced, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face.
1) Facing Maximum Permeance Rating: 0.05 perm
2) Basis of Design Product: Johns Manville FSK-25 Faced Batts.
2. Available Manufacturers:
a. CertainTeed Corporation.
b. Guardian Fiberglass, Inc.
c. Johns Manville.
d.. Owens Corning.

C. Loose Granular Perlite Insulation: Expanded perlite complying with ASTM C 549, Type II (surfaced treated for water repellency and limited moisture absorption) or IV (surface treated for water repellency and limited moisture absorption), R-values of 3.3 – 2.8 for densities of 4.1 – 7.4 lbs. per cu. ft. at 75 deg. F (23.9 deg. C).

D. Auxiliary Insulation: *
1. Polyethylene Vapor Retarder: 6-mil polyethylene film, with laboratory-tested vapor transmission rating of 0.2 perms, natural color.
2. Paper-Laminate Vapor Retarder: Kraft paper sheets laminated together with asphalt or other vapor retarding compound, with laboratory-tested vapor transmission rating of 0.5 perms, scrim reinforced at edges of sheets.

3. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, and complying with requirements for fire performance characteristics.
4. Mechanical Anchors: Type and size indicated or, if not indicated, as recommended by insulation manufacturer for type of application and condition and condition of substrate.
5. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filing voids in work.
6. Eave Ventilation Troughs: Preformed rigid fiberboard or plastic sheet designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

E. Foamed-In-Place Insulation:
1. Property Product "Polymaster R-501.
2. Polymaster R-501 is a 3-part polymer foamed-in-place plastic insulation consisting of a proprietary dry powder resin mixed with a catalyst and foamed with nitrogen or compressed air. The foam hardens through a chemical process similar to that of epoxy resin. Complete drying requires 72 hours or more, depending on local environment conditions.

PART 3 – EXECUTION

3.01 PREPARATION

A. Remove protrusions, dirt, dust, oil, grease, and other materials that could impair adhesion.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, snow, and, for polystyrene foam board insulations, sunlight.
C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
D. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
E. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
F. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
G. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

3.03 INSTALLATION OF PERIMETER WALL INSULATION SUPPORTING BACKFILL

A. On below-grade walls and grade beams at building perimeter, install polystyrene board insulation units with long edges oriented horizontally.
1. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
2. If not otherwise indicated, extend perimeter insulation a minimum of 48 inches below exterior grade line.
B. Protect below-grade insulation on vertical surfaces from damage during backfilling by installing protection course.

3.04 INSTALLATION OF UNDER-SLAB INSULATION

A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
   1. Install under-slab insulation prior to placement of under-slab vapor retarders.

   2. If not otherwise indicated, lay under-slab insulation tight against perimeter walls or grade beams in a minimum 24 inches wide strip.

B. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.05 INSTALLATION OF BLANKET INSULATION

A. Install glass-fiber blanket insulation in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
   4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
   5. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:
      a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
      b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

B. Stuff unfaced glass-fiber blanket insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.06 INSTALLATION OF FOAMED-IN-PLACE INSTALLATION

A. Preparation:
   1. Handle and store product according to Polymaster recommendations. Ensure cores or spaces are free of mortar or other restrictions to the free flow of foam insulation. Verify that all work within the wall voids is complete prior to installation. Allow masonry mortar to set prior to installing insulation. Select the most aesthetically pleasing locations for foam injection, including locations to be concealed where possible, such as: masonry joints, wythe side of walls and covered side of walls.
   2. For pressure fill installation, drill fill holes into CMU cores. Drill hole size: minimum diameter 5/8" (15.9 mm), maximum diameter 1" (254 mm).

B. Execution:
   1. Limitation: Do not install foam insulation when product [CMU] temperature is below 50 degrees F.
   2. Install foam insulation in CMU cores to a uniform density using the pressure fill method or the top fill method. Completely fill all spaces, crevices and voids. If pressure fill method is used, fill and paint drill holes in masonry units with mortar after installation.
   3. Verify complete filling of voids by drilling or removal of block face. Fill and paint drill holes in masonry with mortar after inspection. Correct any foam installation found to be noncompliant with manufacturer's requirements. Complete installation recommendations are available from the manufacturer.
   4. Fill all open cells and voids in hollow concrete masonry walls where shown on drawings. The foam insulation shall be pressure injected through a series of 5/8" to 1" holes drilled into every vertical column of block cells (every 8" on center) beginning at an approximate height of four (4) feet from finished floor level. Repeat this procedure at an approximate height of twelve (12) feet above the first horizontal row of holes (or as needed) until the void is completely filled.

5. Patch holes with mortar to resemble existing surface.

C. Testing:

1. Verify insulation density of each foam batch by random sampling of foam before installation. Fill a 1 gal (3.8 L) nonsealing plastic bag with foam. The bag weight shall be between 285 – 325 grams. [lbs]

3.08 INSTALLATION OF VAPOR RETARDERS *

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated.

B. Sealing Joints:

1. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end and bottom edges, at perimeter of wall openings and at lap joints; space fasteners 16” o.c.
2. Seal overlapping joints in vapor retarders with adhesives per vapor retarder manufacturer’s printed directions. Seal butt joints and fastener penetrations with tape of type recommended by vapor retarder manufacturer. Locate all joints over framing members or other solid substrates. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
3. Seal joints caused by pipes, conduits, electrical boxes and similar items penetrating vapor retarders with cloth or aluminized tape of type recommended by vapor retarder manufacturer to create an air-tight seal between penetrating objects and vapor retarder.

C. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with tape or another layer of vapor retarder.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements for rigid insulation board on foundation walls, exterior concrete slabs below grade and at miscellaneous locations shown on the drawings.
   1. Membrane protection board for protection of membrane is specified.

B. Related Requirements:
   1. Sheet Membrane Waterproofing 07-13-53.

1.02 ADMINISTRATIVE

A. Coordination:
   1. Coordinate work with the application of "Sheet Membrane Waterproofing".

1.03 ACTION SUBMITTAL

A. Product Data:
   1. Submit:
      a. Product Data: Provide data on product characteristics, performance criteria, and limitations.
      b. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation, and installation techniques.

1.04 SITE CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 – PRODUCTS

2.01 INSULATION

A. Material Properties:
   1. Rigid closed-cell extruded polystyrene thermal board insulation.
   2. Comply with ASTM C 578-19, Type IV, density 1.6 lb/cu. ft. min., compressive strength 25 psi (ASTM D 1621-16).
   3. Thermal resistance: 5-year aged R-values of 5.4 and 5.0 min., °F-ft^2-h/Btu^2/inch at 40°F and 75°F respectively (ASTM C 518-17).
   4. Water absorption: Max. 0.3% by volume (ASTM C 272-18).

B. Thickness: 2" unless otherwise indicated.

C. Acceptable manufacturer's product: Dow Chemical Company "STYROFOAM ® Brand Square Edge (SE)" material.

D. Adhesive: Type recommended by insulation manufacturer.

E. Acceptable manufacturer's products:
   1. ChemRex, Inc. "Contech Brand PL300 Foam Board Adhesive".
   2. Dakar Products, Inc. "Foamgrab PS".

2.02 PROTECTION BOARD

A. Protection board shall be rigid board material, as approved by the sheet membrane manufacturer for use with their membrane. Installation materials and methods shall be per membrane manufacturer's requirements for installing their system. Protection boards shall be of the type suitable to protect horizontal and vertical membrane installations.

2.03 ACCESSORIES

A. Mechanical fastening thru sheet membrane waterproofing or sheet barriers will not be permitted.

PART 3 – EXECUTION

3.01 PREPARATION

A. Verify that all masonry joints are struck flush and that other conditions are satisfactory for proper installation.
B. Remove concrete fins and mortar projections that interfere with placement of insulation boards.

3.02 INSTALLATION

A. Erection:
   1. Vertical Insulation: Apply insulation boards to outside face of exterior foundation walls except where otherwise indicated. Adhere insulation to wall by applying 2" diameter spots of adhesive to insulation boards 16" o.c. both ways.
   2. Horizontal Insulation: Apply insulation boards under and in contact with floor slab-on-grade where vertical perimeter insulation is not feasible and elsewhere as indicated. Install insulation so it is firmly supported with edges in moderate contact.
   3. Cut insulation to fit snugly around pilasters, projections, curves and irregularities on the wall surface. Fill voids with insulation.
B. Tolerances:
   1. Cut and fit rigid boards tight to protrusions or interruptions to the rigid board plane.
   2. Do not displace or damage sheet membrane waterproofing during installation of rigid board coverings.

3.02 CLEAN-UP

A. Remove and dispose of excess insulation, wrappings and other waste materials.

END OF SECTION

SECTION 07550
PROTECTED MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cold Applied 2-Ply Asphalt Roofing (StressPly, OptiMax, or Versiply). (2.2.)(3.4)

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry.

B. Section 06114 - Wood Blocking and Curbing: Wood nailers and cant strips.

C. Section 07220 - Insulation Board: Insulation and fastening.

D. Section 07620 - Sheet Metal Flashing and Trim: Weather protection for base flashings.

E. Section 07710 - Manufactured Roof Specialties: Counter flashing gravel stops, and fascia.

F. Section 08620 - Unit Skylights: Skylight frame and integral curb and counter flashing.

G. Section 08630 - Metal-Framed Skylights: Skylight frame and integral curb and counter flashing.

1.3 REFERENCES

A. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

B. ASTM D 312 - Standard Specification for Asphalt used in Roofing.

C. ASTM D 451 - Standard Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.

D. ASTM D 1079 Standard Terminology Relating to Roofing, Waterproofing and Bituminous Materials.

E. ASTM D 1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

F. ASTM D 1863 Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.

G. ASTM D 2178 Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

H. ASTM D 2824 Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.

I. ASTM D 4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.

J. ASTM D 4601 Standard Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.

K. ASTM D 5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Materials.

L. ASTM D 6162 Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous

Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.

M. ASTM E 108 - Standard Test Methods for Fire Test of Roof Coverings

N. Factory Mutual Research (FM): Roof Assembly Classifications.

O. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual.

P. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

Q. Underwriters Laboratories, Inc. (UL): Fire Hazard Classifications.

R. Warnock Hersey (WH): Fire Hazard Classifications.

S. ANSI-SPRI ES-1 Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

T. ASCE 7, Minimum Design Loads for Buildings and Other Structures

U. UL - Fire Resistance Directory.

V. FM Approvals - Roof Coverings and/or RoofNav assembly database.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Perform work in accordance with all federal, state and local codes.

B. Exterior Fire Test Exposure: Roof system shall achieve a UL, FM or WH Class rating for roof slopes indicated on the Drawings as follows:
1. Factory Mutual Class A Rating.
2. Warnock Hersey Class A Rating.

C. Design Requirements:
1. Uniform Wind Uplift Load Capacity
a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
1) Design Code: ASCE 7, Method 2 for Components and Cladding.
2) Importance Category:
a) IV
3) Importance Factor of:
a) 2.0
4) Wind Speed: 120 mph
5) Ultimate Pullout Value: Adhered
6) Exposure Category:
a) B.
7) Design Roof Height: 20 feet.
8) Minimum Building Width: 30 feet.
9) Roof Pitch: 1/2 :12.
2. Snow Load: 25 psf.
3. Live Load: 20 psf, or not to exceed original building design.
4. Dead Load:
a. Installation of new roofing materials shall not exceed the dead load capacity of the existing roof structure.

D. Roof System membranes containing recycled or bio-based materials shall be third party certified through UL Environment.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation instructions.

C. Shop Drawings: Submit shop drawings including installation details of roofing, flashing, fastening, insulation and vapor barrier, including notation of roof slopes and fastening patterns of insulation and base modified bitumen membrane, prior to job start.

D. Design Pressure Calculations: Submit design pressure calculations for the roof area in accordance with ASCE 7 and local Building Code requirements. Include a roof system attachment analysis report, certifying the system's compliance with applicable wind load requirements before Work begins.

E. Recycled or Bio-Based Materials: Provide third party certification through UL Environment of roof System membranes containing recycled or bio based materials.

F. Verification Samples: For each modified bituminous membrane ply product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

G. Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.

H. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Testing must be performed at 77 deg. F. Tests at 0 deg. F will not be considered.

I. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

J. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic inspection and maintenance of all completed roofing work. Provide product warranty executed by the manufacturer. Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified with documented ISO 9001 certification and minimum of twelve years of documented experience and must not have been in Chapter 11 bankruptcy during the last five years.

C. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience and a certified Pre-Approved Garland Contractor.

D. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.

E. Product Certification: Provide manufacturer's certification that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

F. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section.

B. Review installation procedures and coordination required with related Work.

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging with labels intact until ready for installation.

B. Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 4 inches above ground level and covered with "breathable" tarpaulins.

C. Stored in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface except store KEE-Stone FB 60 rolls flat on a clean flat surface. No wet or damaged materials will be used in the application.

D. Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50 degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.

E. Avoid stockpiling of materials on roofs without first obtaining acceptance from the Architect/Engineer.

F. Adhesive storage shall be between the range of above 50 degree F (10 degree C) and below 80 degree F (27 degree C). Area of storage shall be constructed for flammable storage.

1.9 COORDINATION

A. Coordinate Work with installing associated metal flashings as work of this section proceeds.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.11 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed Edge-To-Edge NDL System Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the installer, the manufacturer shall provide

the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition including Garland Metal Components.

1. Warranty Period:
    a. 30 + 10 years from date of acceptance. Requires mid period inspection.

B. Installer is to guarantee all work against defects in materials and workmanship for a period indicated following final acceptance of the Work.

1. Warranty Period:
    a. 2 years from date of acceptance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Garland Company, Inc. (The)
2. SR Products
3. Ecology
4. Firestone
5. Viking Products Group

B. Or approved equal provided all sections of the specifications are met.

C. The Products specified are intended and the Standard of Quality for the products required for this project. If other products are proposed the bidder must disclose in the bid the manufacturer and the products that they intend to use on the Project. If no manufacturer and products are listed, the bid may be accepted only with the use of products specified.

1. Bidder will not be allowed to change materials after the bid opening date.
2. If alternate products are included in the bid, the products must be equal to or exceed the products specified. Supporting technical data shall be submitted to the Architect/ Owner for approval prior to acceptance.
3. Substitution request must:
    a. Be submitted no less than (7) days prior to bid due date.
    b. Include a list of nearby installations more than (2) years old.
    c. Include sample warranty.
    d. Be accompanied by third-party testing reports which indicate equal or great performance characteristics.
4. In making a request for substitution, the General Contractor, Bidder/Roofing Contractor represents that it has:
    a. Personally investigated the proposed product or method, and determined that it is equal or superior in all respects to that specified.
    b. Will provide the same guarantee for substitution as for the product and method specified.
    c. Will coordinate installation of accepted substitution in work, making such changes as may be required for work to be completed in all respects.
    d. Will waive all claims for additional cost related to substitution, which consequently become apparent.
    e. Cost data is complete and includes all related cost under his/her contract or other contracts, which may be affected by the substitution.
    f. Will reimburse the Owner for all redesign cost by the Architect for accommodation of the substitution.
5. Architect/ Owner reserves the right to be the final authority on the acceptance or rejection of any or all bids, proposed alternate roofing systems or materials that has met ALL specified requirement criteria.
6. Failure to submit substitution package, or any portion thereof requested, will result in

immediate disqualification and consideration for that particular contractors' request for manufacturer substitution.

2.2 COLD APPLIED 2-PLY ROOF SYSTEM – BASES OF DESIGN

A. Base (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. StressBase 80:

B. Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. OptiMax FR Mineral:

C. Interply Adhesive: (1 and 2)
   1. Weatherking :

D. Flashing Base Ply: One ply bonded to the prepared substrate with Interply Adhesive:
   1. HPR Tri-Base Premium:

E. Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate with Interply Adhesive:
   1. OptiMax FR Mineral:

F. Flashing Ply Adhesive:
   1. Flashing Bond:

G. Surfacing: Requires 30 day wait before applying.
   1. Surface Coatings:
      a. Garla-Brite:

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.

C. Verify that work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.

D. If substrate preparation and other conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation.
   1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
   2. Fill substrate surface voids that are greater than 1/4 inch wide with an acceptable fill material.
   3. Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
   4. Wherever necessary, all surfaces to receive roofing materials shall be power broom and vacuumed to remove debris and loose matter prior to starting work.
   5. Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
   6. Fasteners and plates for fastening components mechanically to the substrate shall provide a minimum pull-out capacity of 300 lbs. (136 k) per fastener. Base or ply sheets attached with

cap nails require a minimum pullout capacity of 40 lb. per nail.

7. Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

3.3 INSTALLATION - GENERAL

A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.

B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
   1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
   2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.

C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water

D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.4 INSTALLATION COLD APPLIED ROOF SYSTEM

A. Base Ply: Cut base ply sheets into 18 foot lengths and allow plies to relax before installing. Install base sheet in Interply Adhesive: applied at the rate required by the manufacturer. Shingle base sheets uniformly to achieve one ply throughout over the prepared substrate. Shingle in proper direction to shed water on each large area of roofing.
   1. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
   2. Solidly bond to the substrate and adjacent ply with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.
   3. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Use care to eliminate air entrapment under the membrane.
   4. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
   5. Extend plies 2 inches beyond top edges of cants at wall and projection bases.
   6. Install base flashing ply to all perimeter and projection details.
   7. Allow the one ply of base sheet to cure at least 30 minutes before installing the modified membrane. However, the modified membrane must be installed the same day as the base plies.

B. Modified Cap Ply(s): Cut cap ply sheets into 18 foot lengths and allow plies to relax before installing. Install in interplay adhesive applied at the rate required by the manufacturer. Shingle sheets uniformly over the prepared substrate to achieve the number of plys specified. Shingle in proper direction to

shed water on each large area of roofing.

1. Lap ply sheet ends 8 inches. Stagger end laps 12 inches minimum.
2. Solidly bond to the base layers with specified cold adhesive at the rate of 2 to 2-1/2 gallons per 100 square feet.
3. Roll must push a puddle of adhesive in front of it with adhesive slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.
4. Install subsequent rolls of modified across the roof as above with a minimum of 4 inch side laps and 8 inch staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
5. Allow cold adhesive to set for 5 to 10 minutes before installing the top layer of modified membrane.
6. Extend membrane 2 inches beyond top edge of all cants in full moppings of the cold adhesive as shown on the Drawings.

C. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives, hot asphalt or mechanically attached with approved plates and fasteners.

D. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06114.

1. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
2. Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
3. Nailer lengths should be spaced with a minimum 1/8 inch gap for expansion and contraction between each length or change of direction.
4. Nailers and flashings should be fastened in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.

E. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07620 or Section 07710. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.

F. Termination Bar: Provide a metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.

G. Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.

1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
3. Adhere to the underlying base ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
4. Solidly adhere the entire flashing ply to the substrate. Secure the tops of all flashings that are not run up and over curb through termination bar fastened at 6 inches (152 mm) O.C. and sealed at top.
5. Seal all vertical laps of flashing ply with a three-course application of trowel-grade mastic and fiberglass mesh.
6. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.

7. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.
8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

H. Flashing Cap Ply:
1. Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
2. Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.
3. Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 8 inches (203 mm) o.c. from the finished roof at all vertical surfaces.
4. Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
5. Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
6. All stripping shall be installed prior to flashing cap sheet installation.
7. Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
8. Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 4 inches on center and covered with an acceptable counter flashing.

I. Surface Coatings: Apply roof coatings in strict conformance with the manufacturer's recommended procedures.

J. Roof Walkways: Provide walkways in areas indicated on the Drawings.

3.5 CLEANING

A. Clean-up and remove daily from the site all wrappings, empty containers, paper, loose particles and other debris resulting from these operations.

B. Remove asphalt markings from finished surfaces.

C. Repair or replace defaced or disfigured finishes caused by Work of this section.

3.6 PROTECTION

A. Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.

B. Protect exposed surfaces of finished walls with tarps to prevent damage.

C. Plywood for traffic ways required for material movement over existing roofs shall be not less than 5/8 inch (16 mm) thick.

D. In addition to the plywood listed above, an underlayment of minimum 1/2 inch (13 mm) recover board is required on new roofing.

E. Special permission shall be obtained from the Manufacturer before any traffic shall be permitted over new roofing.

3.7 FIELD QUALITY CONTROL

A. Inspection: Provide manufacturer's field observations at start-up and at intervals of approximately 30 percent, 60 percent and 90 percent completion. Provide a final inspection upon completion of the Work.
   1. Warranty shall be issued upon manufacturer's acceptance of the installation.
   2. Field observations shall be performed by a Sales Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
   3. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
   4. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

3.8 SCHEDULES

A. Base (Ply) Sheet:
   1. StressBase 80: 80 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass scrim, performance requirements according to ASTM D 5147.
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 100 lbf/in XD 100 lbf/in
         2) 50mm/min. @ -17.78 +/- 2 deg. C MD 17.5 kN/m XD 17.5 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 110 lbf XD 100 lbf
         2) 50mm/min. @ 23 +/- 2 deg. C MD 489 N XD 444 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 0 +/- 3.6 deg. F MD 4 % XD 4 %
         2) 50mm/min@ -17.78 +/- 2 deg. C MD 4 % XD 4 %
      d. Low Temperature Flexibility, ASTM D 5147, Passes -40 deg. F (-40 deg. C)

B. Thermoplastic/Modified Cap (Ply) Sheet:
   1. OptiMax FR Mineral: 145 mil mineral surfaced, polyurethane modified roofing membrane with fire retardant characteristics, and dual fiberglass reinforced scrim. ASTM D 6163, Type III Grade G
      a. Tensile Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 205 lbf/in XD 215 lbf/in
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 36.0 kN/m XD 38 kN/m
      b. Tear Strength, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 300 lbf XD 300 lbf
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 1334 N XD 1334 N
      c. Elongation at Maximum Tensile, ASTM D 5147
         1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.7% XD 5.0%
         2) 50 mm/min. @ 23 +/- 2 deg. C MD 4.7% XD 5.0%
      d. Low Temperature Flexibility, ASTM D 5147, Passes 0 deg. F (-18 deg. C)

C. Interply Adhesive:
   1. Weatherking:Rubberized, polymer modified cold process asphalt roofing bitumen V.O.C. compliant ASTM D 3019. Performance Requirements:
      a. Non-Volatile Content ASTM D 4479 70%
      b. Density ASTM D1475 8.9 lbs./gal.
      c. Viscosity Stormer ASTM D562 400-500 grams
      d. Flash Point ASTM D 93 100 deg. F min. (37 deg. C)
      e. Slope: up to 3:12

D. Flashing Base Ply:
1. HPR Tri-Base Premium: 60 mil SBS (Styrene-Butadiene-Styrene) rubber modified roofing base sheet reinforced with a fiberglass and polyester composite scrim, performance requirements according to ASTM D 5147.
a. Tensile Strength, ASTM D 5147:
1) 2 in/min. @ 73.4 +/- 3.6 deg. F: MD 330 lbf/in XD 330 lbf/in
2) 50 mm/min. @ 23 +/- 2 deg. C MD 57.5 kN/m XD 57.5 kN/m
b. Tear Strength, ASTM D5147:
1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 550 lbf XD 550 lbf
2) 50 mm/min. @ 23 +/- 2 deg. C MD 2446 N XD 2446 N
c. Elongation at Maximum Tensile, ASTM D 5147:
1) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 7% XD 9%
2) 50 mm/min. @ 23 +/- 2 deg. C MD 7% XD 9%

E. Flashing Ply Adhesive:
1. Flashing Bond: Asphalt roofing mastic V.O.C. compliant, ASTM D 4586, Type II trowel grade flashing adhesive.
a. Non-Volatile Content ASTM D 4479 70 min.
b. Density ASTM D 1475 8.3 lbs./gal. (1kg/l)
c. Flash Point ASTM D 93 103 deg. F (39 deg. C)

F. Surfacing:
1. Flashing Cap (Ply) Sheet:
a. OptiMax FR Mineral: 145 mil mineral surfaced, polyurethane modified roofing membrane with fire retardant characteristics, and dual fiberglass reinforced scrim. ASTM D 6163, Type III Grade G
1) Tensile Strength, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 205 lbf/in XD 215 lbf/in
b) 50 mm/min. @ 23 +/- 2 deg. C MD 36.0 kN/m XD 39 kN/m
2) Tear Strength, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 300 lbf XD 300 lbf
b) 50 mm/min. @ 23 +/- 2 deg. C MD 1334 N XD 1334 N
3) Elongation at Maximum Tensile, ASTM D 5147
a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 4.7% XD 5.0%
b) 50 mm/min. @ 23 +/- 2 deg. C MD 4.7% XD 5.0%
4) Low Temperature Flexibility, ASTM D 5147, Passes 0 deg. F (-18 deg. C)
2. Surface Coatings:
a. Surfacing:
1) Garla-Brite: ASTM D 2824 aluminum coating non-fibered aluminum roof coating non-fibered aluminum roof coating having the following characteristics:
a) Flash Point 103 deg. F (39 deg. C) min.
b) Weight/Gallon 7.9 lbs./gal. (1.0 g/cm3)

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes custom-site fabricated sheet metal flashing trim and appurtenances.
B. Related Requirements:

1.02 REFERENCES

A. Abbreviations:
   1. ASTM – American Society of Testing Materials.
   2. SMACNA – Sheet Metal and Air Conditioning Contractors National Association
B. Reference Standards:
   1. Architectural Sheet Metal Manual "SMACNA".
   2. ASTM B209-14 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   4. ASTM A792 Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   5. ASTM A653 Standard Specification for Steel Sheet, Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

1.03 ADMINISTRATIVE REQUIREMENT

A. Pre-installation project meeting.
   1. Measure and verify the existing downspout arrangement.

1.04 ACTION SUBMITTAL

A. Product Data: For each product indicated.
B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions, and details for fastening, joining, supporting, and anchoring sheet metal flashing and trim.
C. Samples: For each type of sheet metal flashing and trim finish and profile.

1.05 CLOSEOUT SUBMITTAL

A. Guaranty: The guaranty period for all items covered by this Section shall be for one [1] year from date of Owner equipment acceptance, as specified in the General Conditions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sheet Metals:
   1. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
      a. Clear Anodic Finish: Class II, AA-M12C22A31, complying with AAMA 611.
   2. Stainless-Steel Sheet: ASTM A 240, Type 304, No. 2D finish.
   3. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
      a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.

b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
c. Exposed Finishes: Apply the following coil coating:
1) High-Performance Organic Finish: As specified in Division 5 Section "Shop-Applied Metal Coatings."

B. Miscellaneous Materials:
1. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
2. Gutter Accessories: Wire ball downspout strainer.
3. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D 4397.
4. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
a. Fastener Length: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than ¾ inch for wood screws.
b. Fastener Material:
1) Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
2) Aluminum: Use aluminum or stainless-steel fasteners.
3) Stainless Steel: Use stainless-steel fasteners.
5. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
6. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
a. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
7. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
8. Sealants: As specified in Division 7 Section "Joint Sealants".

2.02 FABRICATION

A. Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
B. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
C. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal, and in thickness not less than that of metal being secured.
E. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints and seams at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.

2.03 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
B. Downspouts: Provide downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Downspout Style: Rectangular SMACNA Figure 1-32B.
2. Hanger Style: U-shaped with concealed fasteners SMACNA Figure 1-35A.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous manufacturers of dissimilar metals.
   1. Coat side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
   3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints and seams at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.

G. Seams and Joints: As specified under Seams and Joints Article in Part 2 above.

H. Seal joints with sealants as specified in Division 7 Section “Joint Sealants” as required for watertight construction.

3.02 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of rood drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with butyl sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes list of joint sealants for specific use, schedule of application and installation procedures.
B. Related Requirements:
   1. 04-nn Masonry specification.

1.02 REFERENCES

A. Abbreviations:
   1. Exposure: T-traffic / NT-non-traffic.
   2. Grade: P-pourable/NS- non-sag
   3. Type: M-multi-compound, S-single compound
   4. Use: (contact surbage) M-mortar, concrete
      G-Glass
      A-aluminum
      O-Other: wood, galv. steel
   5. Class: nn % elongation/compression

B. Reference Standards:
ASTM C 920 – Specification for Elastomeric Joint Sealants
ASTM C 834 – Specification for Latex Sealants
ASTM C 1311 – Specification Solvent Release Sealants
ASTM C 1330 – Specification for Backing for Cold Applied Sealants
ASTM C 1193 – Standard Guide for Use of Joint Sealants

1.03 ACTION SUBMITTALS

A. Product data:
   1. Product Data: For each joint-sealant product indicated.
   2. Samples for Initial Selection for Standard Colors: For each type and color of interior joint sealant scheduled as a standard color for selection. Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.04 CLOSEOUT SUBMITTALS

A. Warranty:
   1. Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1.05 DELIVERY STORAGE

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

1.06 SITE CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:
   1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturers.
   2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40 deg F (4.4 deg C).
   3. When joint substrates are wet due to rain, frost, condensation, or other causes.

B. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by joint sealer manufacturer for application indicated.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Elastomeric Sealants:
   1. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   2. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and quality for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

B. Solvent-Release Joint Sealants:
   1. Acrylic-Based Solvent-Release Joint Sealant: Comply with ASTM C 1311.
   2. Butyl-Rubber-Based Solvent-Release Joint Sealant: Comply with ASTM C 1299.

C. Latex Joint Sealants:
   1. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
   2. Refer to separate Joint Sealant Products Schedule for a list of acceptable latex sealant products.

D. Joint Sealant Backing:
   1. General: Provide ASTM C 1330 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.
   2. 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.

E. Miscellaneous Materials:
   1. 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.
   2. 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 nonporours surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
   3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.02 JOINT SEALANT SCHEDULE

						EXPOSURE		USES				JOINT SIZE	
MANUFACTURER	PRODUCT	CHEMISTRY	TYPE	GRADE	CLASS	T	NT	M	G	A	O	MIN	MAX
Tremco	Mono 555	Acrylic	S	NS	7 1/2	--	NT	--	--	--	--	--	--
Pecora	BC-158	Butyl	S	NS	7 1/2	--	NT	--	--	--	--	--	--
Sonneborn	Multi-Purpose	Butyl	S	NS	7 1/2	--	NT	--	--	--	--	--	--
Tremco	Tremco Butyl	Butyl	S	NS	7 1/2	--	NT	--	--	--	--	--	--
Pecora	AC-20+	Latex	S	NS	0	--	NT	--	--	--	--	--	--
Sonneborn	Sonolac	Latex	S	NS	0	--	NT	--	--	--	--	--	--
Tremco	Tremflex 834	Latex	S	NS	0	--	NT	--	--	--	--	--	--
USG	SHEETROCK Acoustical Sealant	Acoustical Latex	S	NS	Min	--	NT	--	--	--	--	--	--
Dow Coming	786 Mildew Resistant	MR Silicone	S	NS	25	--	NT	--	G	A	O	· X ·	1
GE Silicones	Sanitary SCS1700	MR Silicone	S	NS	25	--	NT	--	G	A	O	1/4 X 1/4	1 X ·
Tremco	Tremsil 200	MR Silicone	S	NS	25	--	NT	--	G	A	--	1/4 X 1/4	1 X 1/2
Pecora	898	MR Silicone	S	NS	50	--	NT	M	G	A	O	· X ·	1 X ·
Tremco	Spectrem 1	Silicone	S	NS	100/50	--	NT	M	G	A	O	1/4 X 1/4	1 X 1/2
Dow Coming	995	Silicone	S	NS	50	--	NT	--	G	A	O	1/4 X 1/4	1 X ·
Dow Coming	756 H.P.	Silicone	M	NS	50	--	NT	M	G	A	O	1/4 X ·	2 X 1/2
Dow Coming	FC Parking Structure Sealant	Silicone	M	P	100/50	T	NT	M	--	A	O	1/4 X 1/4	3 X 1/2
Dow Coming	FC Parking Structure Sealant	Silicone	S	NS	100/50	T	NT	M	G	A	O	1/4 X ·	3 X 1/2
Dow Coming	SL Parking Structure Sealant	Silicone	S	P	100/50	T	NT	M	--	A	O	1/4 X 1/4	3 X 1/2
GE Silicones	SilPruf LM SCS2700	Silicone	S	NS	100/50	--	NT	M	G	A	O	1/4 X 1/4	2 x ·
Pecora	Dynatrol I-XL	Urethane	S	NS	25	--	NT	M	G	A	O	1/4 X 1/4	1 1/2 X 1/2
Sika	Sikaflex - 1a	Urethane	S	NS	25	T	NT	M	G	A	O	1/4 X 1/4	2 X 1/2
Sonneborn	NP 1	Urethane	S	NS	25	T	NT	M	G	A	O	1/4 X 1/4	2 X 1/2
Sonneborn	Ultra	Urethane	S	NS	25	T	NT	M	G	A	O	1/4 X 1/4	1 X 1/2
Pecora	Dynatrol II	Urethane	M	NS	50	--	NT	M	G	A	O	1/4 X 1/4	2 X 1/2

PART 3 – EXECUTION

3.01 PREPARATION

A. Material Selection:
1. Provide Type, Grade, Glass and Use classes as listed below.
a. Type M (multicomponent) sealants where required to achieve color match indicated and where specifically indicated.
b. Type S (single component) or Type M sealants elsewhere.
c. Grade P (pourable) or Grade NS (nonsag) sealants at horizontal joints.
d. Grade NS sealants at vertical and non-horizontal joints.
e. Class: Sealants suitable for anticipated joint movement.
f. Use T (traffic) at horizontal traffic surfaces.
g. Use NT (nontraffic) or T at vertical and horizontal non-traffic surfaces.
h. Use I (immersible) at joints subject to continuous immersion.

B. Joint Sealant Usage, Table

ID No.	Exterior Traffic Joints	Chemistry	Class
E-1	Control and expansion joints in concrete, cast-in-place	Silicone	50
E-5	Joints between paving & walls & other vertical surfaces	Silicone	50
ID No.	Exterior Non-Traffic Joints	Sealant Chemistry	Class
E-22	Control and expansion joints in concrete, cast-in-place	Silicone	50
E-31	Joints between metal flashings, concealed lapped joints	~~Butyl~~	~~7 1/2~~
E-32	Joints between metal flashings, exposed, prefinished	~~Silicone~~	~~50~~
E-34	Joints between metal panels, prefinished	~~Silicone~~	~~50~~
E-37	Perimeter joints around frames, metal, field painted	~~Urethane~~	~~25~~
E-39	Perimeter joints around frames, metal, prefinished	~~Silicone~~	~~50~~
E-40	Setting bed for flashing receivers, metal frames	~~Butyl~~	~~7 1/2~~
E-41	Setting bed for thresholds & sills, wood frames	~~Butyl~~	~~7 1/2~~
ID No.	Interior Traffic Joints	Sealant Chemistry	Class
I-3	Control and expansion joints in concrete slabs, exposed	Urethane	25
I-5	Control and expansion joints in decorative concrete slabs, exposed	~~Urethane~~	~~25~~
ID No.	Interior Non-Traffic Joints	Sealant Chemistry	Class
I-20	Control and expansion joints in cast-in-place concrete	Urethane	25
I-26	Control and expansion joints in unit masonry, concrete	Urethane	25
I-30	Control joints in gypsum board ceilings and partitions	Acrylic	7 1/2
I-34	Joints between woodwork, painted and adjacent surfaces	Acrylic or latex	0
I-39	Joints in and between solid surfacing and adjacent surfaces	Silicone	50
I-42	Perimeter joints around frames, metal, prefinished	Silicone	50

C. Preparation:
1. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
a. Clean pourous 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 after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

b. Remove laitance and form-release agents from concrete.
   1) Clean nonpourous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

2. 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.

3. 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.

3.02 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. 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.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that 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 in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. 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 sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.03 CLEANING

A. Clean off excess sealant 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.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the description of steel doors and frames for locations shown on the drawings.
   1. Standard; exterior doors- insulated; interior doors- non insulated.
   2. Fire Rated is noted on the drawings.

B. Related Requirements:
   1. Masonry 04-nn-nn.

1.02 REFERENCES

A. Abbreviations:
   1. ASTM – American Society of Testing Material.
   2. NFPA – National Fire Protection Association.
   3. SDI – Steel Door Institute.

B. Reference Standards:

Recommended Specifications: Standard Steel Doors and Frames, (SDI-100).
NFPA – 80 “Standard for Fire Doors and Windows”.
ASTM – E152 “Standard Method of Fire Tests”.

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
   2. Provide Schedule of doors and frames using same reference numbers for details and openings as those on Contract Documents.

B. Product Data:
   1. Submit manufacturer’s technical product data substantiating that products comply with requirements.

1.04 DELIVERY & STORAGE

A. Delivery:
   1. Deliver hollow metal work cartooned or crated to provide protection during transit and Site storage. Provide additional sealed plastic wrapping for factory-finished doors.
   2. Inspect hollow metal work upon delivery for damage. Minor damage may be repaired, provided refinished items are equal in all respects to new work and acceptable to ENGINEER; otherwise, remove and replace damaged items as directed.

B. Storage: Store doors and frames at building Site under cover. Place units on minimum 4 inches 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 ¼-inch spaces between stacked doors to promote air circulation.

1.05 SITE CONDITION

A. Environmental: Normal ambient temperatures at the Facility range from zero 0 degF to 115 degF.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Design
1. Provide doors and frames complying with Steel Door Institute "SDI-100".
2. 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 and have been tested, listed, and labeled in accordance with ASTM E 152.

B. Frames
1. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on Drawings and Schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 14-gauge galvanized cold-rolled furniture steel.
   a. Fabricate frames with mitered and welded corners, ground smooth.
   b. Form exterior frames of hot-dip galvanized steel.
2. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.

C. Manufacturers: Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
1. Steel Doors and Frames:
   a. Amweld/Div. American Welding & Mfg. Co.
   b. Ceco Door Products.
2. Thermal Rated Steel Door and Frame Assemblies:
   a. Ceco Corp.
   b. Curries Mfg., Inc.

2.02 MATERIALS

A. Door:
1. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 1011 and ASTM A 568.
2. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 1008 and ASTM A 568.
3. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 653 and G60 zinc coating, mill phosphatized.

B. Accessories:
1. Supports and Anchors: Fabricate of not less than 18-gauge galvanized sheet steel.
2. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanized items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.
3. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints and which can be used on both submerged and non-submerged ferrous metal.

2.03 ASSEMBLY/FABRICATION

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp, or buckle. Identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at Project Site. Comply with SDI-100 requirements as follows:
1. Interior Doors: SDI-100, Grade II, heavy-duty, Model 4, minimum 18-gauge galvanized faces.
2. Exterior Doors: SDI-100, Grade III, extra heavy-duty, Model 4, minimum 16-gauge galvanized faces.

B. Assembly
   1. Exposed Fasteners: Unless otherwise indicated, provide galvanized countersunk flat Phillips heads for exposed screws and bolts.
   2. Thermal-Rated (Insulating) Assemblies:
      a. At exterior locations and elsewhere as shown or Scheduled, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 1363.
      b. Unless otherwise indicated, provide thermal-rated assemblies with U-factor of 0.24 Btu(hour per ft. sq. per degree F).
   3. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and template provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.
      a. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at Project Site.
      b. Locate finish hardware as indicated on final Shop Drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

C. Shop Painting:
   1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
   2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
   3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint. Primer shall be applied at the rate of 1.5 dry mils or as recommended by the paint. Primer shall be applied at the rate of 1.5 dry mils or as recommended by the paint manufacturer to provide the proper base for the finish coat

2.04 QUALITY CONTROL

A. Certification: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, submit manufacturer's certification for that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install standard steel doors, frames, and accessories in accordance with final Shop Drawings, manufacturer's data, and as specified in this Section.

B. Placing Frames: Comply with provisions of SDI-105, "Recommended Erection Instructions for Steel Frames," unless otherwise indicated.
   1. Except for frames located at in-place interior concrete or masonry, place frames prior to construction at enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
   2. In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels.
   3. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.
   4. Install fire-rated frames in accordance with NFPA Std. No. 80.

C. Door Installation:
   1. Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.02 ADJUST CLEAR

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION

SECTION 08 71 00

FINISH HARDWARE

PART 1 - GENERAL

1.1 REFER TO "GENERAL AND SPECIAL CONDITIONS", AND "INSTRUCTIONS TO BIDDERS", DIVISION 1 OF SPECIFICATIONS. REQUIREMENTS OF THESE SECTIONS AND THE PROJECT DRAWINGS SHALL GOVERN WORK IN THIS SECTION.

1.2 WORK INCLUDED:

A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry.
2. Section 06 20 00 – Finish Carpentry: Installation of finish hardware.
3. Section 08 11 13 – Hollow Metal Doors and Frames
4. Section 08 14 16 – Flush Wood doors.
5. Section 08 41 00 – Aluminum Doors and Frames
6. Section 28 31 00 – Fire Detection and Alarm
7. Section 28 10 00 – Electronic Access Control and Intrusion Detection
8. Electrical rough-in, conduit junction boxes, wiring, primary power and final hook-up of all finish hardware components requiring electrical connections.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
3. Provide hardware for fire-rated openings in compliance with NFPA 80 and State local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.
4. Where emergency exit devices are required on fire-rated doors that carry supplementary marking on the doors UL labels indicating "fire door to be equipped with fire exit hardware" provide UL label on exit devices indicating "Fire Exit Hardware".

B. Hardware Supplier:

Shall be an established firm dealing in contract builder's hardware. He must have an adequate inventory and qualified personnel on staff. Only domestic manufacturers are acceptable. The distributor must be a

factory-authorized dealer for all materials required. Supplier shall be or have in employment an Architectural Hardware Consultant. (AHC)

1. Prior to Bidding all suppliers and Contractors may meet at the jobsite to verify all work that is to be performed and to coordinate efforts with Access Control work., Review specification requirements for hardware schedule, doors, and labor to be performed.

C. Hardware installer shall be a an experienced hardware Specialist

D. Pre-installation Meeting:

1. Before hardware installation, general contractor/construction manager shall request a hardware installation seminar be conducted on the installation of hardware; specifically of locksets, closers, exit devices, overhead stops and coordinators. The hardware supplier for the project shall present seminar. Seminar to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Seminar to address proper coordination and installation of hardware, per finish hardware schedule for this specific project by using installation manuals, hardware schedule, templates and physical product samples Manufacturer's representative, hardware supplier, Hardware installers, and owner's representatives shall attend the Pre-installation meeting. Arrangements for this meeting shall be made 2 weeks prior to convening. Only qualified installers who attend this meeting shall be allowed to perform hardware installation.
2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
   a. Convene one week prior to commencing work of this Section.
   b. Coordinate with section 01039
3. The hardware supplier shall include the cost of this seminar in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 SUBMITTALS:

A. Hardware Schedule

1. Submit proper number of Hardware Schedules to allow the Architect to retain two copies for his use, plus the number of copies required by the Contractor for his distribution and use. But, in any event, do not submit more than six copies.
2. Include the following:

   Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

3. Hardware Locations: Refer to Article 3.1 B.2 Locations.

4. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
5. Hardware Description: Quantity, category, product number, fasteners, and finish.
6. Headings that refer to the specified Hardware Set Numbers.
7. Scheduling Sequence shown in Hardware Sets.
8. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
9. Riser drawings, wiring drawings and system operation description.
10. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
11. Typed Copy.
12. Double Spacing.
13. 8-1/2 x 11 inch sheets
14. U.S. Standard finish symbols or BHMA Finish symbols.
15. Generally, follow guidelines established in Door & Hardware Institute Handbook" Sequence and Format for the Hardware Schedule". Modified as above

B. Product Data:

1. Submit, in booklet form using supplier's schedule covers as binders, Product Data of items of hardware listed in supplier's schedule.
2. Submit Product Data concurrently with hardware schedule.
3. Provide Elevation and Riser Diagrams for all Electrical openings being furnished. Coordinate operational descriptions with Security and Access Control providers. Provide proper documentation to Security and Access Control Provider for their wiring of the system.

C. Inspection Report:

1. Submit inspection report specified in 3.1.C.2. for locksets, exit devices, ADA special closers, door closers and all electrical hardware.

D. Key Schedule: Provide Key Schedule with submitted Hardware Schedule

E. Submit System Operation Description as part of the original hardware schedule submittal. Failure to include will result in the schedule being returned not reviewed and not approved.

F. Submit to general contractor/construction manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the Contractor.

1.6 WARRANTIES

A. Cylindrical locksets shall carry manufacturer's 7-year warranty against manufacturing defects and workmanship.

B. Closers shall carry manufacturer's 30-year warranty against manufacturing defects and workmanship.

C. ADA Power operators shall carry manufacturer's 2 year warranty against manufacturing defects and workmanship

D. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.

E. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.

F. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Inspect the work within 24 hours after receipt of notice from the Owner. Replace work found to be defective as defined in the Contract Documents.

PART 2 - PRODUCT

2.1 FURNISH EACH CATEGORY WITH THE PRODUCTS OF ONLY ONE MANUFACTURER UNLESS SPECIFIED OTHERWISE; THIS REQUIREMENT IS MANDATORY WHETHER VARIOUS MANUFACTURERS ARE LISTED OR NOT.

2.2 PROVIDE THE PRODUCTS OF MANUFACTURER DESIGNATED OR IF MORE THAN ONE MANUFACTURER IS LISTED, THE COMPARABLE PRODUCT OF ONE OF THE OTHER MANUFACTURERS LISTED. WHERE ONLY ONE MANUFACTURER OR PRODUCT IS LISTED, "NO SUBSTITUTION" IS IMPLIED.

A. Hinges:

1. Unless specified otherwise in sets furnish hinges of class and size as follows:
2. Furnish class 5BB1 and size 4-1/2 x 4-1/2 inches unless otherwise specified. Provide HW hinges where shown in HW Sets.
3. Numbers used are IVES. Equal products of Hager, McKinney and Stanley are acceptable.

B. Continuous Hinges shall be Ives 112/224 XY series. Equivalent by Pemko or Select is acceptable.

C. Mortise Locksets: Schlage L Series. Trim to be 03

1. Acceptable Equivalent to be Sargent 8200, or Best 45H Series
2. Verify all lock functions with owner prior to ordering.

D. Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1 ½" in diameter, and double heat treated pinion shall be 11/16"in diameter with double D slab drive arm connection.
2. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
3. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).

4. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule. No extras will be allowed for these accessory items.
5. Provide Special Templates as required.
   LCN 4000 Series and 4640 Series Power Operators. Size of Closers:
   a. Closing power of sized closers shall be adjustable to increase closing power fifty 50% percent.
   b. Closing power of non-sized cylinders shall be adjustable over a range of sizes.
6. Barrier Free Manual Closers:
   a. All closers for openings that must meet the minimum requirements of the 1990 ADA act, in lieu of ANSI Standard A156.4, shall be sized in accordance with the applicable Reduced Opening Force table in the current LCN General Catalog.
   b. All size 1 manual closers shall provide less than 5 pounds opening force on a 36” door leaf and delay closing time in accordance with the 1990 ADA requirements.

E. Overhead Holders and Stops:

1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
   a. Glynn-Johnson or equivalent by ABH or Rixson

F. Kick Plates:

1. Furnish .050 inches thick 10" high x door width less 2" at single doors, and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less
2. Kickplates shall be drilled and counter sunk for oval head, counter sunk screws. Pan head not acceptable.
   a. Equivalent by Rockwood or Trimco

G. Bumpers and Wall Stops

1. Ives: Bumpers to be WS407CVX or CCV.
2. B.H.M.A. L02101. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.

H. Thresholds to be saddle type 5” wide by length of opening. Minimum wall thickness to be .244. Zero as shown. Equivalent by Pemko is acceptable.

I. Door bottoms shall be Zero.

J. Jamb and Head Seal for Hollow metal Frames shall be Zero 429A. Mount Weatherstripping prior to mounting closers or Exit Devices. Notching of Weatherseal is not acceptable. Mounting holes drilled due to mounting weatherstripping after closers and exit devices must be patched to original condition of door and frame or door and frame must be replaced at no cost to the owner.

K. Intumescent Seals for wood fire rated doors shall be by Dr Supplier based on Category A Doors. Coordinate with Wood Door specification. Use National Guard 9850C if Category B Doors are specified.

L. Fasteners:

1. Furnish fasteners of the proper type, size, quantity, and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction**.** Furnish machine screws for attachment to reinforced hollow metal frames and reinforced aluminum frames.. "TEK" type screws are not acceptable.

M. Miscellaneous:

Furnish items not categorized in the above descriptions but specified by manufacturers names in Hardware Sets.

2.3 FINISHES:

A. Generally, Dull Chrome, US26D / BHMA 626 or 652 for steel based products

B. Exit device touchbars, push/pull bars, pull, push plates, kick plates, overhead holders and stops and wrought bumpers, Dull Stainless Steel, US32D / BHMA 630.

C. Closers: Powder Coat. Finish to be Aluminum BHMA 689

D. Thresholds: Aluminum extrusion

2.4 TEMPLATES AND HARDWARE LOCATION:

A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.

B. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 CYLINDERS KEY CONTROL AND KEYING:

A. Key to owners existing key system. Key as directed by owner.

B. Provide 2 Change Keys per locked cylinder. Keys to be nickel silver.

C. Provide 8 Masterkeys

D. Provide Temporary cylinders during construction as needed

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install hardware according to manufacturers installations and to manufacturers template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
2. Reinforced hollow metal doors and frames and reinforced aluminum door and frames: drilled and tapped machine screws.
3. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.

B. Locations:
1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY	DIMENSION
Hinges	Door Manufacturer's Standard
Levers	Door Manufacturer's Standard
Exit Device Touchbar	Per Template

C. Final Adjustment:

1. Provide the services of a factory representative to inspect material furnished and its installation and adjustment, to make final hardware adjustment, and to instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets, closers and exit devices shall be inspected by the factory representative and adjusted after installation and after the HVAC system is in operation, to insure correct installation and proper adjustment in operation. The manufacturer's representative shall prepare a written report stating compliance, and also recording locations and kinds of noncompliance. The original report shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner

DOOR HARDWARE
Section 08 71 00

Hardware Group No. 01
For use on Door #(s):
4

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 03A L583-363	626	SCH
1	EA	MORTISE CYL	AS REQ. COORDINATE W/ OWNERS STANDARD	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4111 EDA SRI	689	LCN
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP W/ DRIP	8198AA	AA	ZER
1	EA	THRESHOLD	655A	A	ZER

Hardware Group No. 02
For use on Door #(s):
9

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 03A L583-363	626	SCH
1	EA	MORTISE CYL	AS REQ. COORDINATE W/ OWNERS STANDARD	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH SRI	689	LCN

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes color and coding of painting for process facilities.
B. Related Requirements:
   1. Painting Sections 09-97-nn.

PART 2 – PRODUCTS [Specific Technical Specification]

PART 3 – EXECUTION

3.01 PAINT COLOR SCHEDULE

	Piping System		Color	Tnemec Color Chip
A.	Water - Raw Well Water		Dark Blue	20 BL
	- Finished/Potable		Light Blue	17 BL
	- Service Water			
	- Backwash/Drain	Brown	41 BR	
B.	Waste - Sanitary		Dark Grey	41 GR
	- Final Effluent		Light Grey	45 GR
	- Sludge		Light Brown	39 BR
	- Drain Vent			
C.	Chemical – Chlorine		Safety Yellow	025 F
	- Orthophosphate		Safety Orange	045 F
	- Potassium Permanganate		Violet	145 F
D.	Miscellaneous			
	- Compressed Air		Safety Green	095 F
	- Low Air		Green/Dark Green Barrel	095 F/085 F
	- Gas		Safety Red	065 F
	- Sample Lines		Black	35 GR
E.	Structure/Building		Selected by Owner	
	- Walls			
	- Ceiling			
	- Floor		Hardner	
	- Structural Steel			

3.02 PROCESS PIPING MARKING

All process piping shall be marked/stenciled indicating the fluids in the piping system and direction of flow.

A. Paint shall be semi-gloss.
B. Identify exposed piping every eight (8) feet on straight run and of at each side of the penetration of a structure and/or enclosure.

Pipe/Insulation Outside diameter	Height of Letter Fluid Description
¾” to 1-1/4”	½”
1-1/2” to 2”	¾”
2-1/2” to 6”	1-1/2”
8” to 10”	2”
Over 10”	2-1/2”
Equipment	2-1/2”

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes procedures and material requirement for Gypsum Board as noted on the drawings.

1.02 REFERENCES

A. Abbreviation:
   1. ASTM – American Society of Testing Material.
B. Reference Standards:
   1. ASTM C 1396 – Standard Specification for Gypsum Board.
   2. ASTM C 840 – Standard Specification for Application & Finishing of Gypsum Board.
   3. ASTM C 475 – Standard Specification for Joint Compounds and Joint Tape for Finishing Gypsum Board.

1.03 ACTION SUBMITTAL

A. Submit product data shields for the Work prepared.

1.04 DELIVERY STORAGE

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
B. Store materials include under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.
C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.05 SITE CONDITIONS

A. Minimum Room Temperatures: For finishing of gypsum board maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously thereafter until drying is complete.
B. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Georgia-Pacific Corp.
B. Gold Bond Building Products Div., National Gypsum Co.
C. United States Gypsum Co.

2.02 MATERIALS

A. Gypsum Board shall conform to the following:
   1. Gypsum Board: A gypsum core wall board surfaced with paper on front, back, and long edges and complying with ASTM C 1396.
      a. Thickness: ½”
      b. Width: 4’

c. Length: 6’ through 16’.
d. Edge: Beveled Tapered.

2. Fire-Resistant Gypsum Board: A gypsum core wall board with additives to enhance fire resistance of the core and surfaced with paper on front, back, and long edges and complying with ASTM C 1396, type X.
a. Thickness: ½”
b. Width: 4’.
c. Length: 6’ through 16’ (1/2” Fire-Shield C Gypsum Board, 5/8” Fire-Shield C Gypsum Board).
d. Edge: Beveled Tapered.

B. Fasteners:
1. Nails shall be GWB54, annular ring conforms to ASTM 514.
2. Screws shall be type W conforming to ASTM C 1002.

C. Joint Sealant:
1. Paper tap and compounds for joint sealing shall be supplied by the Gypsum Board Manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Gypsum Board shall be the thickness noted on the drawings.
1. Fire Resistant Board Type X shall be used where noted on the drawings.

B. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 841.

B. Locate exposed end butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

C. Fastening procedures shall be as follows:
1. Nails shall be spaced not to exceed 7” on ceilings, or 8” on sidewalls, a minimum of 3/8” and a maximum of ½” from edges and ends of gypsum board.
2. If framing is spaced up to 16” o.c., screws are spaced 12” o.c. max on ceilings and 16” o.c. max on walls. If framing is spaced 24” o.c., screw spacing must not exceed 12” o.c. Minimum screw penetration shall be 5/8” for wood studs.

D. Finishing shall consist of taping, fill width joint compound, and sanding of all gypsum board joints.

END OF SECTION

SECTION 093500

CHEMICAL-RESISTANT TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chemical-resistant tile.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
2. Installer employs only installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
3. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 CHEMICAL-RESISTANT TILE PRODUCTS

A. Chemical-Resistant Tile Type CRT-1: Unglazed square-edged quarry tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Daltile.
b. Interceramic.
c. Quarry Tile Co.
d. Sonoma Tilemakers.

2. Face Size: 6 by 6 inches (152 by 152 mm) Verify in field to match existing sizes.
3. Thickness: 1/2 inch (12.7 mm)
4. Wearing Surface: Abrasive aggregate embedded in surface.
5. Dynamic Coefficient of Friction: Not less than 0.42.
6. Tile Color and Pattern: Manufacturer's best match to existing sample, subject to approval by architect.
7. Grout Color: Match existing, subject to architect's approval of submitted sample**.**
8. Precoat with temporary protective coating.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

2.3 TILE BACKING PANELS

A. Fiberglass - Mat Faced Gypsum Backerboard

1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum, LLC Densglass sheathing or comparable product Subject to approval by architect.
   a. Thickness: 1/2 inch. Project Name/Number/Date 06 16 43-4 Gypsum Sheathing
   b. Width: 4 feet.
   c. Length: [8 feet] [9 feet] [10 feet].
   d. Weight: 1.9 lb/sq. ft.
   e. Edges: Square.
   f. Surfacing: Fiberglass mat on face, back, and long edges.
   g. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 540 pounds per square foot, dry.
   h. Flexural Strength, Parallel (ASTM C473): 80 lbf, parallel.
   i. Humidified Deflection (ASTM C1177): Not more than 2/8 inch.
   j. Permeance (ASTM E96): Not less than 23 perms.
   k. R-Value (ASTM C518): 0.56.
   l. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
   m. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week protocol): Will not support microbial growth.

2.4 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Laticrete International, Inc.
b. MAPEI Corporation.

2. For wall applications, provide nonsagging mortar.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Minerals & Chemicals, Inc.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

D. Chemical-Resistant Furan Mortar: ANSI A118.5

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Minerals & Chemicals, Inc.
b. Sauereisen.

2.5 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Minerals & Chemicals, Inc.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

B. Chemical-Resistant Furan Grout: ANSI A118.5, with carbon filler.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Minerals & Chemicals, Inc.
b. Sauereisen.

2.6 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Chemical-Resistant Sealants: Provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Minerals & Chemicals, Inc.
b. Sauereisen.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Temporary Protective Coating: Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) according to ASTM D87 and formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CHEMICAL-RESISTANT TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with 3/**8-inch (9.5-mm)** joint width.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

H. Install fiber-cement backer board and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.5 CHEMICAL-RESISTANT TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete:

1. Chemical-Resistant Tile Installation 1: TCNA F114 and ANSI A108.1A; cement mortar bed (thickset) with cleavage membrane.

    a. Chemical-Resistant Tile Type: CRT-1.
    b. Bond Coat for Cured-Bed Method Portland cement mortar.
    c. Grout: Chemical-resistant furan.

END OF SECTION 093500

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes preparation of surfaces, materials and application of paints on all types of interior building surfaces.
B. Related Requirements:

1.02 REFERENCES

A. Abbreviations:
   1. DFT – Dry Film Thickness.
   2. SF/G – Square Feet Per Gallon.
B. Reference Standards:
   1. ASTM – American Society Testing Materials.
   2. SSPC – Structural Steel Painting Council.
   3. NACE – National Association of Corrosion Engineers

1.03 ACTION SUBMITTALS 01-33-00

A. Product Data:
   1. Submit data sheets for the specified paint/mix/system.
   2. Submit standard and safety color chip for approval.

1.04 CLOSEOUT SUBMITTALS

A. Spare Parts: Upon completion of the work, deliver to Owner an extra stock of paint equal to 2% two percent (minimum 2 pints) of each type of finish paint.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

1.06 DELIVERY AND STORAGE

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.07 SITE CONDITIONS

A. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.
B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 – PRODUCTS

2.01 PAINT SCHEDULE

A Mixes: The paint schedule is based on Tnemec Protective Coating Systems and is intended to provide the painting system required for each application.

1. Interior Structural Steel:
   a. Preparation: Solvent Clean SP-1, Touch up damaged areas of primer.
   b. Finish: Semi-Gloss.
   c. Primer: Tnemec Series 37H Chem-Prime HS at 2.0-3.0 mils DFT.
   d. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   e. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   f. Total System: 10.0-15.0 mils DFT.
2. Interior Concrete Masonry (New Construction):
   a. Primer (spot): Tnemec Series 130-6602 Envirofill at 85-100 sq ft per gallon.
   b. Intermediate: Tnemec Series 113 HB Tneme-Tufcoat at 4.0-6.0 mils DFT.
   c. Finish: Tnemec Series 113 HB Tneme-Tufcoat at 4.0-6.0 mils DFT.
   d. Total System: 8.0-12.0 mils DFT.
3. Interior Concrete Masonry (Existing Painted Construction):
   a. Primer: Tnemec Series 151 Elasto-Grip FC at 180-400 sq ft per gallon.
   b. Intermediate: Tnemec Series 113 HB Tneme-Tufcoat at 2.0-3.0 mils DFT.
   c. Finish: Tnemec Series 113 HB Tneme-Tufcoat at 2.0-3.0 mils DFT.
   d. Total System: 6.0-10.0 mils DFT.
4. Interior Ceiling Galvanized Metal Deck, etc:
   a. Finish: Tnemec Series 115 Unibond DF at 2.0-4.0 mils DFT.
   b. Total System: 2.0-4.0 mils DFT.
5. Interior Ceiling Previously Coated Metal Deck, etc.:
   e. Finish: Tnemec Series 115 Unibond DF at 2.0-4.0 mils DFT.
   f. Total System: 2.0-4.0 mils DFT.
6. Metal Doors and Frames:
   a. Finish: Gloss.
   b. First Coat: 37-77 Chem-Prime 2.0 to 3.5 Mil Dry Film.
   c. Second Coat: 2 H Hi-Build Tneme-Gloss 1.5 to 3.5 Mil Dry Film.
   d. Third Coat: 2 H Hi-Build Tneme-Gloss 1.5 to 3.5 Ml Dry Film.
7. Premanufactured Wall Panels
   a. Primer: Tnemec Series 151 Elasto-Grip FC at 180-400 sq ft per gallon.
   b. Intermediate: Tnemec Series 113 HB Tneme-Tufcoat at 2.0-3.0 mils DFT.
   c. Finish: Tnemec Series 113 HB Tneme-Tufcoat at 2.0-3.0 mils DFT.
   d. Total System: 8.0-12.0 mils DFT.
8. Interior Structural Steel Previously Coated:
   a. Finish: Tnemec Series 115 Unibond DF at 2.0-4.0 mils DFT.
   b. Total System: 2.0-4.0 mils DFT.
9 Interior Concrete Masonry (Unpainted Old Construction):
   a. Prepare surface per 3.02
   b. Primer: Tnemec Series 130-6602 Envirofill at 85-100 sq ft per gallon.
   c. Intermediate: Tnemec Series 113 HB Tneme-Tufcoat at 4.0-6.0 mils DFT.
   d. Finish: Tnemec Series 113 HB Tneme-Tufcoat at 4.0-6.0 mils DFT.
   e. Total System: 8.0-12.0 mils DFT.

10. Interior Plaster & Gypsum Wallboard (New Construction):
    a. Primer: Tnemec series 151-1051 Elasto-Grip FC at 1.0-2.0 mils DFT.
    b. Finish: Tnemec Series 113 HB Tneme-Tufcoat at 4.0-6.0 mils DFT.
    c. Total System: 5.0-8.0 mils DFT.
11. Concrete Floor:
    a. Colored Hardner.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
   2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify the Engineer about anticipated problems using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

B. Cleaning, Existing Surfaces (greater than one year of age): Prior to painting, grind or scrape off all surface defects such as fine, protrusions, bulges, and mortar spatter.
   1. On concrete surfaces, remove non-degraded release agents, oil, wax and grease by scraping off heavy deposits and washing with hot tri-sodium phosphate solution (2 lbs. tri-sodium phosphate per gallon 160° F water). Repeat the process until the contamination is removed. After cleaning, flush with clean, warm water to remove residual cleaning solution. Existing surfaces shall be "Detergent Water Cleaned" or "Steam Cleaned" in accordance with ASTM D4258 [Standard Practice for Surface Cleaning Concrete for Coatings]. Laitance and other loosely bound material must be removed from the surface prior to coating. Acceptable surfaces shall be free of oil, grease, or loose concrete. Abrade the surface if necessary. Allow surfaces to dry thoroughly before coating.
   2. On Galvanized steel and other non-ferrous metals: remove dust and dirt by blowing off the surface with high pressure air, or wiping clean with dry rags. Oil, grease, protective mill coatings, and other soluble contaminants should be removed by solvent cleaning in accordance with SSPC-SP1. White rust should be removed from galvanized steel by hand or power brushing. Care should be taken not to damage or remove the galvanizing. Rust should be removed from old galvanized steel by Hand or Power Tool Cleaning in accordance with SSPC- SP2 or SP3
   3. On Previously Coated metal Deck, joists, etc: remove dust and dirt by blowing off the surface with high pressure air, or wiping clean with dry rags.
   4. Metal Doors and Frames: Power Tool Cleaning must comply with SSPC-SP-3. Seal top and bottom edges with primer and then finish with 2 coats.
   5. On Structural Steel surfaces: the surface preparation must comply with SSPC-SP2 (Hand Tooling Cleaning) and- SSPC-SP3 (Power Tool Cleaning). Before cleaning by use of either hand or power tool, remove

visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1. Hand and Power tool cleaning removes all loose mill scale, loose rust and other detrimental foreign matter.

6. Premanufactured Wall panels: Abrade the surface to generate a profile for mechanical adhesion.

7. Solvent Cleaning as specified in SSPC-SP1 is a method for removing all visible oil, grease, soil drawing and cutting compounds, and other soluble contaminants. Change rags and cleaning solution frequently. Adequate ventilation is required.

C. Do not begin paint application until these requirements have been met and concrete has cured for at least 28 days. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

3.03 APPLICATION

A. Apply paint in accordance with paint schedule requirements, the cited reference, all codes and regulations, and the recommendations of the paint manufacturer. Do not apply paint in areas where dust is being generated.

B. Do not apply paint when the surrounding air temperature is outside of the parameters listed in this specification.
1. Dew or moisture condensation should be anticipated and if such conditions are prevalent, delay painting until certain that the surfaces can be kept above the dew point. Follow all additional environmental limitation requirements of the paint manufacturer.
2. Contractor shall supply and operate heating and/or moisture control equipment to maintain temperature/moisture appropriate for paint application.

C. Paint material mil thickness and numbers of coats that are indicated in the paint schedules are based on brush or roller application. Spray application of paint materials will be allowed in the field only for areas or surfaces that are very difficult to paint with brush or roller. Field spray application must be approved by the Engineer before its initiation. For areas that are spray painted, apply as many coats as necessary to achieve specified mil thickness.

D. Allow sufficient drying time between coats of paint. During adverse weather, extend length of drying time as recommended by the paint manufacturer.

E. Prior to applying each paint coating after the first, check mil thickness of previously applied coating(s). Correct for insufficient paint thickness by increasing the mil thickness of subsequent applications, if allowed by the paint manufacturer or by applying additional coatings to provide the specified paint thickness.

3.04 CLEANUP

A. During the progress of the work, do not allow the accumulation of empty containers or other excess items except in areas specifically set aside for that purpose. Following completion of painting in each area, promptly remove all masking and temporary protection. After paint has dried, reinstall all items removed for painting. Upon completion of this portion of the work, visually inspect all surfaces and remove paint and traces of paint from surfaces not scheduled to be painted.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes preparation of surfaces, materials and application of paints on process piping equipment and ferrous metals.
B. Related Requirements:

1.02 REFERENCES

A. Abbreviations:
   1. DFT – Dry Film Thickness.
   2. SF/G – Square Feet Per Gallon.
B. Reference Standards:
   1. ASTM – American Society Testing Materials.
   2. SSPC – Structural Steel Painting Council.

1.03 ACTION SUBMITTALS 01-33-00

A. Product Data:
   1. Submit data sheets for the specified paint/mix/system.
   2. Submit standard and safety color chip for approval.

1.04 CLOSEOUT SUBMITTALS

A. Spare Parts: Upon completion of the work, deliver to Owner an extra stock of paint equal to 2% two percent (minimum 2 pints) of each type of finish paint. Containers shall be tightly sealed, dated and clearly labeled.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

1.06 DELIVERY AND STORAGE

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.07 SITE CONDITIONS

A. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F and 95 deg F.
B. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 – PRODUCTS

2.01 MIXES – NEW CONSTRUCTION

The paint schedule is based on Tnemec Protective Coating Systems and is intended to provide the painting system required for each application.

A. Interior and exterior Ductile Iron Pipe:
   1. Preparation: Brush Blast; SP-7
   2. Finish: Semi-Gloss.
   3. Primer: Tnemec Series 37H Chem-Prime HS at 2.0-3.0 mils DFT.
   4. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   5. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   6. Total System: 10.0-15.0 mils DFT.

B. Interior and exterior PVC Pipe:
   1. Preparation: Solvent Clean SSPC-SP1 Clean and Dry.
   3. Finish: Semi-Gloss.
   4. First Coat: 66 Hi build Epoxoline 6.0 Mil Dry Film.

C. Interior and exterior Steel Pipe:
   1. Preparation: Hand Tool Clean SP-2
   2. Finish: Semi Gloss.
   3. Primer: Tnemec Series 37H Chem-Prime HS at 2.0-3.0 mils DFT.
   4. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   5. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   6. Total System: 10.0-15.0 mils DFT.

D. Submerged and exterior Equipment:
   1. Preparation: Power Tool; SP-3
   2. Finish: Semi-Gloss.
   4. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   5. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   6. Total System: 10.0-15.0 mils DFT.

E. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

F. "Dark Hunter Green" Color is required for all exterior piping, electrical boxes, and conduit.

2.02 MIXES – EXISTING FACILITY

The paint schedule is based on Tnemec Protective Coating Systems and is intended to provide the painting system required for each application.

A. Interior Steel:
   1. Preparation: Power Tool Cleaning SP-3; areas of active corrosion; Power Cleaning to Bare Metal, SP-11.
   2. Finish: Semi-Gloss.
   3. Primer: Tnemec Series 27 F.C. Typoxy at 2.0-3.0 mils DFT.
   4. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   5. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
   6. Total System: 10.0-15.0 mils DFT.

B. Interior Ductile Iron Pipe:
   1. Preparation: Brush Blast. SP-7
   2. Finish: Semi-Gloss.

3. Primer: Tnemec Series 27 F.C. Typoxy at 2.0-3.0 mils DFT.
4. Intermediate: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
5. Finish: Tnemec Series 66 Hi-Build Epoxoline at 4.0-6.0 mils DFT.
6. Total System: 10.0-15.0 mils DFT.

C. Interior PVC Pipe:
1. Preparation: Solvent Clean SSPC-SP1 Clean and Dry.
2. Type of System: Epoxy-Polyamide.
3. Finish: Semi-Gloss.
4. First Coat: 66 Hi-Build Epoxoline 6.0 Mil Dry Film.

D. Metal Doors and Frames:
1. Preparation: Power Tool Cleaning SP-3
2. Finish: Gloss.
3. Primer: Tnemec Series 27 F.C. Typoxy at 2.0-3.0 mils DFT.
5. Finish: Tnemec Series 1074 Endura-Shield II at 2.0-3.0 mils DFT
6. Total System: 4.0-6.0 mils DFT.

PART 3 – EXECUTION

3.01 EXAMINATION

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

B. Test shop applied primer for compatibility with subsequent cover materials. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums.

3.02 PREPARATION

A. Fiberglass piping and connected items as shown on the drawings shall remain unpainted. However, stenciled painted arrows, color bands, etc. shall be provided to agree with the Owner's Standard Color Code. Surface shall be lightly sanded below code markings prior to painting to obtain a roughened surface.

B. Galvanized Steel:
1. Priming: Remove surface contamination and oils and wash with Special Spirits prior to priming. Galvanize metal primer shall be Tnemec, Tneme-Grip.
2. Galvanized Surface Repair: Spot prime all abraded galvanized areas to receive finish coats. Abraded galvanized areas shall be cleaned and spot primed with a cold galvanizing compound, Tnemec 90-97 Tneme-Zinc.

C. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by power tool wire brushing (SSPC-SP-3) or where required, sandblasting (SSPC-SP-10 or SSPC-SP-8); by washing with solvent (SSPC-SP-1). Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs. Actual surface preparation procedure shall be based on approved coating manufacturer's published recommendations.

D. Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items.

E. Metal Doors: Seal top and bottom edges with primer and then finish with 2 coats.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Apply each coat to uniform finish. Apply each coat of paint slightly darker than preceding coat unless otherwise approved. Allow applied coat to dry before next coat is applied.

C. Piping:

1. Interior uninsulated black pipe and fitting shall be first prime painted, as specified and given a finish coat of glass enamel to comply with the color code prescribed herein.

2. All pipes with asphaltic or coal tar coatings shall be treated with a minimum of 2 coats of antibleed coating to prevent "bleeding" before finish coats are applied.

D. Material labels and accompanying direction of flow arrows shall be applied to all distribution mains on maximum spacing of 50'. They shall be placed at those points on all main lines where branch mains are extended and on the distribution mains at both sides of all solid building partitions. All labels shall be self-adhesive and suitably coated to make them waterproof, and impervious to dirt.

3.04 CLEANUP

A. Paint exposed conduit and electrical equipment occurring in painted areas.

B. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

C. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows and names.

D. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

SECTION 10 21 13.19

PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures].

B. Related Requirements:
1. Section 061053 "Miscellaneous Rough Carpentry" for blocking.
2. Section 092216 "Non-Structural Metal Framing" for blocking.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:

B. Shop Drawings: For solid-plastic toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.

C. Samples: For each type of toilet compartment material indicated.

1. Include two (2) sets of samples of hardware and accessories involving material and color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For each type of toilet compartment by manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 with Michigan addendums for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AJW Architectural Products.
2. Global Partitions Corp., an ASI Group Company.
3. Marlite.
4. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced.

C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern, as selected by Architect from manufacturer's full range.

D. Pilaster Shoes: Manufacturer's standard design; stainless steel.

E. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or stainless steel.

a. Polymer Color and Pattern: Matching panel

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, Standard Duty: Manufacturer's standard operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position allowing emergency access by lifting door.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for emergency access, and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at outswinging doors

6. Door Pull: Manufacturer's standard unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast-stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast-stainless steel bumper at outswinging doorsMount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast-stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.

2.4 MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

B. Stainless Steel Castings: ASTM A743/A743M.

C. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

D. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.

E. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION OF PLASTIC TOILET COMPARTMENTS

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust, so doors are level and aligned with panels, when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102113.19

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Centrifugal Pumps.

1.02 QUALITY ASSURANCE

A. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
B. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.
C. Pump manufacturer shall have a minimum of 5 years of experience in the manufacture of the type of pump being supplied.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01300.
B. Indicate pump type, capacity, power requirements, and details of construction and installation for the pumps, motors, supports, and accessories.
C. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
D. Submit manufacturer's installation instructions under provisions of Section 01-30-00.
E. Provide one year guarantee as per Section 01-70-00.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01-70-00.
B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01-60-00.
B. Store and protect products under provisions of Section 01-60-00.
C. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 PUMP SELECTION

A. The pump provided shall be a model with the impeller size indicated on the plans standard size larger for this model.

PART 2 - PRODUCTS

2.01 GENERAL

A. All pumps of a particular type shall be by specified in section 2.02.
B. The Drawings show all manufacturers. If an alternate listed manufacturer is proposed, the proposal must include coordination of all trades.

2.02 CENTRIFUGAL PUMPS

A. Manufacturers:
   1. Three Patterson 60Hz 12 X 10 Horizontal Split Case Pump.
      a. TDH: 163 feet
      b. Impeller: 15.4375 inches
      c. Speed: 1800 RPM
      d. Power: 200 hp
B. Electric motors shall be of the voltage and phase as shown on the plans. Motors indicated for VFD service shall be inverter duty rated.
C. Pump casing shall be ductile iron having a minimum tensile strength of 30,000 PSI, meeting ASTM A48-CL30. Flanges shall be ANSI 125# standard.
D. The impeller, upper cutter / cutter nut / cutter box shall be cast steel heat treated to minimum Rockwell C-60. The impeller shall be staticly and dynamically balanced.
E. The pump shaft shall be a heat treated alloy steel.
F. Certified pump curves shall be provided for review and approval prior to shipping the equipment to the site.
G. Pump Characteristics: See plan sheets for pump characteristics.
H. Pumps are Horizontal pumps but shall be installed as Vertical Pumps.

2.03 PUMP CONSTRUCTION

A. Materials:
   1. Housing, Volute, Ductile Iron
   2. Shaft: Heat treated alloy steel
   3. Nuts, bolts and fastening devices: stainless steel
   4. Discharge connection: Ductile iron
B. Pump Design
   1. The casings shall be designed as a Vertical Centrifugal pump design. The casing shall be a split casing.
   2. The pumps shall be designed with a common pump/motor shaft that is with maintenance free permanently lubricated anti-friction bearings. The bearing at the top of the motor shall be a deep groove ball bearing and the radial bearing at the bottom shall be a double row angular ball bearing.
C. Mechanical Seals:
   1. Each pump shall be provided with a double mechanical seal with an oil barrier between them, composed of two separate lapped face seals, each consisting of one stationary and one rotating face.
   2. The oil between the seals shall be environmentally friendly and biodegradable.
   3. Oil reservoir shall be contained in the pump casing. No external oil reservoir.
D. Electric Motors:
   1. Pump motors shall be rated as indicated on the Drawings.
   2. Motor power shall be not less than H.P. indicated on the Drawings.
   3. The motors shall be Vertical Centrifugal design and inverter duty rated where used with VFD's. The motors shall be 3/60/230-480V unless otherwise specified on the pump schedule. Each motor will be fitted with built-in thermostats and seal leak detectors, and shall be monitored in the control panel.
   4. All motors are to be listed explosion proof for Class 1, Group D, Division 1 and Class F insulation.

PART 3 - EXECUTION

3.01 PUMP INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. 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.

3.02 MANUFACTURER'S FIELD SERVICES

A. The equipment manufacturer's representative shall provide field services as specified under Section 01650. Minimum instruction time shall be four (4) hours for each type of pump furnished, plus time required for testing as outlined below.

3.03 TESTING

A. All pumps shall be field tested by Contractor after installation.
B. The performance tests shall be conducted under the supervision of the Engineer, and with the cooperation of the manufacturer's factory representative when called for in the specifications.
C. The Contractor shall furnish the electricity and water needed to conduct the tests.
D. The test shall be carried out by operating each pumping unit through its entire operating range for a continuous period of two hours, or until it is shown to the satisfaction of the Engineer that all of the equipment is in good order and will meet the requirements specified.

END OF SECTION

SECTION 224213.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-mounted, bottom-outlet water closets.
2. Flushometer valves and tanks.
3. Toilet seats.
4. Supports.

B. Related Requirements:
1. None

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valvesto include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets, Floor Mounted, Bottom Outlet:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Standard.
b. Kohler Co.
c. Sloan Valve Company.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.

d. Style: Flushometer valve.
e. Height: **Standard complying with ICC/ANSI A117.1**.
f. Rim Contour: Elongated.
g. Water Consumption: **1.28 gal. (4.8 L)** per flush.
h. Spud Size and Location: NPS 1-1/2 (DN 40); top.
i. Color: **White**.

3. Bowl-to-Drain Connecting Fitting: [**ASTM A1045 or**]ASME A112.4.3.
4. Flushometer Valve: <**Insert flushometer-valve designation**>.
5. Toilet Seat: <**Insert toilet-seat designation**>.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Sloan Valve Company.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig (860 kPa).
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: **Exposed**.
9. Consumption: **1.28 gal. (4.8 L)** per flush.
10. Minimum Inlet: NPS 1 (DN 25).
11. Minimum Outlet: NPS 1-1/4 (DN 32).

2.3 TOILET SEATS

A. Toilet Seats:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: **Commercial (Heavy duty)**.
5. Shape: **Elongated rim, open front**.
6. Hinge: **Self-sustaining**.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: **Not required**.
9. Color: **White**.

2.4 SUPPORTS

A. Water Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.
b. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.
3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.[**Include additional extension coupling, faceplate, and feet for installation in wide pipe space.**]

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vitreous-china, wall-mounted lavatories.
2. Manually operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

B. Related Requirements:
1. None

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for manual faucets.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Ledge Back, Vitreous China, Wall Mounted

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Standard.

b. Kohler Co.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: Rectangular, **19 by 17 inches (483 by 432 mm**.
d. Faucet-Hole Punching: **One hole**.
e. Faucet-Hole Location: Top.
f. Color: **White**.
g. Mounting Material: Chair carrier.

3. Faucet: **lavatory faucet designation from Manually Operated Lavatory Faucets**
4. Support: **Type II, concealed-arm lavatory carrier with escutcheons**.
5. Lavatory Mounting Height: **Standard in accordance with ICC A117.1**.

2.3 MANUALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets - Manual Type: Single-control mixing, commercial.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Standard.
b. Delta Faucet Company.
c. Kohler Co.
d. Moen Incorporated.
e. Zurn Industries, LLC.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Single hole
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: Stainless Steel.
7. Maximum Flow Rate: 0.5 gpm (1.5 L/min.)
8. Maximum Flow: 0.25 gal. (0.95 L) per metering cycle.
9. Mounting Type: Deck, exposedValve Handle(s): Single lever. Spout: Rigid.
10. Spout Outlet: Laminar flow.
11. Operation: Noncompression, manual.
12. Drain: Not part of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. [**NPS 3/8 (DN 10)**] [**NPS 1/2 (DN 15)**].
2. rigid-copper-pipe ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

C. Trap:

1. Size: [**NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32)**] [**NPS 1-1/4 (DN 32)**].
2. Material:

a. Chrome-plated, [**two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall**] [**two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall**] [**one-piece, cast-brass trap with swivel 0.029-inch- (73-mm-) thick tubular brass wall bend**] <**Insert trap type**>; and chrome-plated, brass or steel wall flange.
b. Stainless steel, two-piece trap and swivel elbow with 0.012-inch- (0.30-mm-) thick stainless steel tube to wall; and stainless steel wall flange.

2.6 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lavatories level and plumb in accordance with roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least [**1/2 inch (13 mm))**] high.

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes material and equipment details for ventilation fans and ductwork and appurtenances.
B. Related Requirements:
   1. Electrical Division 26-nn-nn.
   2. Process Instrumentation 40-nn-nn.

1.02 REFERENCES

A. Abbreviations:
B. Reference Standards:
   1. ASHRAE – Handbook Fundamentals; Chapter 33 – Duct Design.
   2. ASHRAE – Handbook Equipment; Chapter 1 – Duct Construction.
   3. ASTM A 653 – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
   4. ASTM A 653 – Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
   5. NFPA 90 A – Installation of Air Conditioning and Ventilating Systems.
   6. SMACNA – Low Pressure Duct Construction Standards.
   7. UL 181 – Factory-Made Air Ducts and Connectors.

1.03 SUBMITTALS

A. Provide product data for items required for this project.
B. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
C. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
D. Submit manufacturer's installation instructions.

1.04 CLOSEOUT SUBMITTALS

A. O&M data.
B. Spare parts.
C. Tools.
D. Guaranty: The guaranty period for all items covered by this Section shall be for one (1) year from date of Owner equipment acceptance, as specified in the General Conditions.

PART 2 – PRODUCTS

2.01 EXHAUST FANS

A. Fan Unit: V-belt driven, nonsparking design with spun aluminum housing; resiliently mounted explosion-proof motor; 2 inch (13 mm) mesh, 0.062 inch (1.6 mm) thick aluminum wire bird screen.
B. Backdraft Damper: Motor actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked. Damper shall be electrically interlocked with the fan and inlet damper.
C. Sheaves; For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
D. Fans capacities shall be as scheduled below. Fans shall be Greenheck Fan Corporation, Penn Ventilator Co., or as approved by the Engineer.

2.02 CORROSION RESISTANT FANS

A. Fans shall be constructed of fiberglass reinforced resin (FRP) with flame retardant additive and shall be belt driven, non-overloading, centrifugal type with flanged inlet and outlet. Motors shall be totally enclosed, fan cooled (TEFC).
B. Fan shaft shall be 1045 carbon steel or 304 stainless steel with portion exposed to the air stream encapsulated in FRP.
C. Fan and motor support bases shall be epoxy coated steel. Fan inlet shall be protected by an epoxy coated expanded metal guard.
D. Corrosion resistant fans shall be Duall Industries FR-008, Industrial Air 163-Size 006 with square-to-round transition on outlet, or as approved.

2.03 IN-LINE FANS

A. Fan shall be duct mounted, belt driven, centrifugal design. Fan housing shall be square and shall be constructed of heavy gauge galvanized steel with duct mounting collars. Fans shall be manufactured by Greenheck Fan Corporation, Penn Ventilator Co. or as approved by the Engineer.
B. The housing shall have two removable access panels located perpendicular to the motor mounting panel.
C. The fan wheel shall be backward inclined, constructed of aluminum. Wheels shall be statically and dynamically balanced. The wheel cone and fan inlet cone shall be carefully matched for maximum performance and operating efficiency.
D. Motors shall be permanently lubricated, heavy duty, ball bearing type and furnished at the specified voltage, phase and enclosure. The drive shall be sized for a minimum of 150% of the driven horsepower. The fan shaft shall be ground and polished solid steel mounted in heavy duty, permanently sealed, pillow block ball bearings. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. The motor pulley shall be adjustable for final system balancing.
E. Fans capacities shall be as scheduled on the Drawings. Fans shall be Greenheck Fan Corporation, Penn Ventilator Co., or as approved by the Engineer.

2.04 FAN SCHEDULE

A. SEE PLANS FOR SIZES.

2.05 SUPPLY AND EXHAUST REGISTERS

A. Manufacturers:
    1. Titus
    2. Other acceptable manufacturers offering equivalent products.
        a. Grillmaster, Inc.
        b. Substitutions: As approved.
B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees.
C. Frame: 1-3 inch margin with countersunk screw mounting.
D. Fabrication: Steel with 20 gage (0.90 mm) minimum frames and 22 gage (0.80 mm) minimum blades, steel and aluminum with 20 gage (0.90 mm) minimum frame, or aluminum extrusions, with factory off-white enamel finish.
E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.06 GRILLES

A. Fixed 2 x 2 x 2 inch aluminum grid, Titus Model No. 50F, Grillmaster Inc. or as approved by the Engineer.
B. Fabricate of aluminum with factory baked enamel finish.

2.07 LOUVERS

A. Louvers shall be 45 degree drainable fixed blade and shall be fabricated with 0.081 inch 6063-T5 extruded aluminum alloy blades in a 4 inch deep 0.081 inch thick 6063-T5 extruded aluminum alloy channel frame. Finish shall be mill.
B. Louvers shall have interior bird screen and shall be American Warming and Heating LE-21 or as approved.
C. Louvers shall be provided with motor operated Dampers electrically interlocked with the fan operation.
D. Structural Performance: Design, engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:
   1. Wind Load: Uniform pressure (velocity pressure) of 20 lbf per sq. ft. acting inwards or outwards.
   2. Wind Load: Uniform pressures (velocity pressures) indicated on drawings, acting inwards or outwards.
   3. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.
      a. Temperature Change (Range): 100 F (55.5 C).
E. Air Performance, Water Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 500.
F. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturers stock units according to ASTM E 90.

2.08 DUCTWORK MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
B. Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.
C. Flexible Ducts; Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 2 inches WG positive and 1.5 inches WG negative for low pressure ducts.
D. Fasteners: Rivets, bolts, or sheet metal screws.
E. Solenoid: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
F. Hanger Rod: Steel, galvanized, threaded both ends, threaded one end, or continuously threaded.
G. Corrosion Resistant Ductwork shall be PVC.

2.09 THERMOSTAT
A. Line voltage thermostat, 120 volt, non-programmable, cool only. Switch action close on the rise.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent

construction dust from entering ductwork system.

E. Locate and place louver units plumb, level, and in proper alignment with adjacent work.

F. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

G. Form closely fitted joints with exposed connections accurately located and secured.

H. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

I. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

J. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.

K. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses where required to make louver joints weathertight. Comply with Division 7 Section "Joint Sealers" for sealants applied during installation of louver.

3.02 ADJUSTING

A. Adjusting air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. 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.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The electrical general requirements, as specified in this Section, shall be applicable to all electrical work. Requirements shown on the Contract Drawings are in addition to these Electrical General Requirements.

B. Related Requirements:
   1. Electrical Division: 26-nn-nn
   2. Process Equipment: 42-nn-nn
   3. Instrumentation: 40-nn-nn

1.2 REFERENCES

A. Abbreviations:
   1. ANSI - American National Standards Institute
   2. ASTM - American Society of Testing and Materials
   3. NFPA - National Fire Protection Association

B. Reference Standards:
   1. ANSI C2 National Electrical Safety Code
   2. ASTM D 178 Standard Specification for Rubber Insulation Matting
   3. NFPA 70 National Electrical Code
   4. IBC Code - Michigan

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with the Work of all trades as necessary to facilitate timely completion, avoid unnecessary cutting and patching and to insure proper installation and operation of all equipment.
   2. Coordinate all components and aspects of the work, in order to minimize power shutdowns to the power distribution systems. Should any part of the Work require an "off-hours" shutdown in excess of 8 hours, supply temporary services or feeders as required to maintain operation of the existing systems and equipment.
   3. The arrangement of electrical equipment and conduit runs as shown on the Contract Drawings and described in the Specifications is schematic. Locate and install electrical work in coordination with other trades so that all electrical equipment and material is installed with working clearances in accordance with NFPA 70. Route conduit to avoid interference with existing installation and with work to be performed by other trades.
   4. The location of equipment and motors shown on the Contract Drawings shall be subject to minor revisions due to field conditions or coordination with other trades without any increase in Contractor's compensation. Prior to roughing-in, verify the exact location of all electrical connections to equipment and motors from reviewed shop drawings and field verification.

1.4 ACTION SUBMITTALS

A. Shop Drawings:
   1. Low Voltage Switchgear
   2. Electric Heater

B. Product Data:

1. Conduit, and fittings
2. Wire and cable
3. Wiring devices
4. Multi-outlet assemblies
5. Outlet and junction boxes
6 Panelboards and cabinets
7 General purpose transformers
8. Circuit breakers
9. Lighting fixtures
10. Pulling devices and end seals
11. Special pull and junction boxes
12. Supporting devices
13. Telemetry Equipment

C. A final copy of the records and certified test reports for all tests, to the Engineer for review, for not less than the following:
1. Insulation testing of 600V (nominal) cables rated 100 amperes (#3 AWG) and above.
2. Ground resistance test of each service ground.
3. Ground fault circuit breaker and receptacle testing.
4. Setting of all adjustable overcurrent devices.
5. Setting or size of all overload elements installed, indicating the following:
   a. Motor designation
   b. Nameplate horsepower, full load current, voltage and phases.
   c. Operating current and voltage.
   d. Overload element size or setting.
6. Emergency power distribution equipment and system test results.

1.5 CLOSEOUT SUBMITTALS

A. O & M Data: Provide O & M manuals.
B. Spare Parts: As required by the individual sections of specifications
C. Tools: As required by the individual sections of specifications
D. Guaranty: The guaranty period for all items covered by this Section shall be for one (1) year from date of Owner equipment acceptance, as specified in the General Conditions. Unless otherwise specified in the individual specification sections.

1.6 QUALITY ASSURANCE

A Regulatory:
1. The electrical installation shall conform to all requirements of ANSI C 2, NFPA 70, and the codes and standards specified in other Sections and all state and local codes.
2. In case of conflict between provisions of codes, laws, and ordinances, the more stringent requirement shall apply.

1.7 DELIVERY STORAGE

A Delivery and Handling:
1. Deliver material in manufacturers' original unopened protective packaging. Handle in a manner to prevent damage to finished surfaces.

B. Storage:
   1 Store materials in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation. Maintain protective coverings until installation is complete and remove such covers as part of final clean up.
   2. Electric equipment noted in the Division and Process Equipment may require on-site electrical service to maintain cabinet heaters.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Plastic Name Plates:
   1. Laminated plastic nameplates consisting of two black sheets with one white sheet bonded to and between the two outer sheets and having letters machine engraved in the face sheet to the depth of the white plastic.
   2. Nameplates shall not be smaller than 1 inch x 3 inches with characters not less than one quarter inch. Where letter sizes are not specified, use one inch high letters for panelboards, switchboards and motor control centers and one quarter inch high elsewhere. Nomenclature shall be according to a schedule approved by the Engineer.
   3. Plates shall have black or white (as directed) Helvetica Medium font lettering, designating:
      a. System
      b. Voltage (where applicable)
      c. Number of phases (where applicable)
      d. Frequency (where other than 60 Hz)
   4. All device plates of receptacles connected to a standby or emergency power distribution system shall be labeled with an orange plastic nameplate, engraved with the panelboard and circuit number to which the receptacle is connected. Nameplate character engraved shall be not less than one quarter inch in height.

PART 3 - EXECUTION

3.1 PREPARATION

A. Location of Equipment
   1. Unless otherwise shown on the Contract Drawings, the location of outlets or devices, from finished floor to center of plate or device, shall be as follows:
      a. Lighting switches: 48 inches
      b. Receptacles: 18 inches
   2. Unless otherwise shown on the Contract Drawings, the location of equipment, from finished floor to top of enclosures shall not exceed 6 feet, 6 inches.
      a. In exposed or public locations, panelboards and cabinets shall be flush mounted unless otherwise noted on the Contract Drawings.
      b. In concealed locations (i.e. closets, electrical/mechanical rooms, non-public locations) panels and cabinets shall be surface mounted, unless otherwise noted on the Contract Drawings.

B. Cutting and Patching:
   1. Perform all cutting and patching of existing construction required for installation of all materials and equipment as specified in this Division.
   2. Perform all patching to match existing adjacent construction to the satisfaction of the Owner/Engineer and using the best possible workmanship of the various trades involved.

3.2 INSTALLATION

A. Nameplates:
1. All parts of equipment, such as switchboards, panelboards, safety switches, motor starters, circuit breakers, time clocks, contactors and similar items shall be identified by name, function or control with name plates.
2. Secure nameplates on equipment or walls with stainless steel or brass screws.

B. Dissimilar Materials:
1. Dissimilar metals are defined as:
   a. Metals which are incompatible and corrosive with one another in the presence of moisture.
   b. Metals which are incompatible and corrosive with one another due to their relative position in the electro chemical series.
   c. Metals which are proven to be incompatible and corrosive with one another from test data.
2. Where dissimilar metals come in contact, corrosion shall be prevented by:
   a. Painting the joint both inside and out with approved coating.
   b. Provide a suitable insulating barrier separating the metals.
   c. Transitions in raceways, from one metal to a dissimilar metal shall only be made at boxes or other enclosures, except where shown on the Contract Drawings.

3.3 FINAL FIELD TESTS

A. Prior to final acceptance testing, the Contractor shall perform the following:
1. Thoroughly clean the entire installation area.
2. Repair any equipment finishes damaged during installation with appropriate materials and in accordance with manufacturer's recommendation.
3. Re-lamp fixtures used during the construction phase.
4. Submit a testing plan to the Engineer/Architect in thirty (30) days before the expected testing date. The plan shall include:
   a. An outline of all tests to be performed.
   b. Qualifications of persons conducting the tests.
   c. Expected results.

B. In addition to other testing required in these specifications, the following field test shall be performed in the presence of the Engineer.
1. Operate all electrical systems and equipment for a period of 24 hours, unless in the opinion of the Engineer, a different test period is required.

C. Any defects found during the testing process shall be promptly corrected and the affected systems retested. The testing process shall continue until the entire installation conforms to the requirements of these specifications and the Contract Drawings.

3.4 COMPREHENSIVE TRAINING AND MANUALS

A. The following "Comprehensive Training" as described in 3.04.B shall be provided. The following manuals shall be provided as described in 3.04.C.2.

B. Provide comprehensive training for Owner personnel through scheduled training courses for the purpose of providing a working knowledge of systems and equipment installed as approved by the Engineer. The training shall cover operation, maintenance and repair of the systems and equipment.
1. The basic text to be used for training shall consist of "As Built" drawings and a Maintenance Manual and an Operations Manual.
2. Utilize the basic test outline above to prepare for approval by the Engineer separate training agendas and course outlines for the maintenance and operational personnel.

3. After approval of training manuals and course outlines, provide not less than two, eight-hour sessions for operation and maintenance personnel which shall include operations, trouble-shooting, debugging, repair procedures, preventive maintenance procedures, and parts replacement.
4. All training shall be provided and completed prior to the commencement of the operational test.

C. All instructions and manuals shall be approved by the Engineer. A draft form of the manuals shall be delivered to the Engineer ten (10) calendar days prior to the commencement of the shop/factory test, if required, and if not required, within ten (10) days prior to the final test. The manuals shall be finalized, subject to revision, prior to the commencement of the operational test. All other documentation items shall be provided prior to the completion of the Work.

1. Instruction

Prepare a separate comprehensive training curriculum to instruct Owner personnel in operation and maintenance of the equipment and components. Such instruction shall include, but not be limited to the following:

a. Operation Instruction
    1. Description of units and component parts.
    2. Start-up, regulation, control, shut-down, and emergency instructions.
    3. Recommendations for types of cleaning agents and methods, including cautions against detrimental agents and methods.
    4. Operating manual shall describe the operation as it relates to user's tasks and shall constitute the basis of instruction.
b. Maintenance Instruction
    1. Operation of all system components.
    2. Complete description and demonstration of all diagnostic procedures and equipment, such as adjustment, checking, disassembly, repair and reassemble, and guide to "troubleshooting" and problem solving and schedule of preventive maintenance procedures.
    3. Maintenance manual shall constitute the basis of instruction.

2. Manuals

Prepare complete, separate, operation and maintenance manuals. Provide information for products specified in this Section and prepare in the form of manuals with an index of contents. Contents shall include as appropriate, but not be limited to:

a. Configuration block diagrams.
b. Scaled layout drawings of floor plans indicating equipment locations.
c. Inventory of all hardware including the manufacturers' name, model number, serial number, name plate data, and overall dimensions.
d. Detailed installation wiring diagrams and cabling diagrams of the system "as built".
e. All terminal markings, cable connector markings and cable lengths.
f. Guidelines for locating faults, isolating the cause of the malfunction, and for the removal, repair, and replacement of all hardware.
g. A chart of common symptoms with suggested remedial action.
h. Complete and detailed operating instructions for all system functions.

END OF SECTION

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Work required under this Section consists of operations, methods, labor and materials for partial interior, exterior, and/or site underground removals with all related items necessary to complete the Work indicated on the Contract Drawings.

PART 2 – Not Used

PART 3 – EXECUTION

3.01 CONDITION OF SITE AND BUILDINGS

A. The condition of site and buildings shall be accepted as found. The Owner will not assume responsibility for conditions found or continuation of conditions existing at time of Proposal invitation or thereafter. Any damage or loss, whether by reason of fire, theft, or other casualty or happening on the site will not relieve the Contractor's obligations to complete the Work.

3.02 PROTECTION OF LIFE, STRUCTURES AND PROPERTY

A. Execute Work to insure against damages to property to remain. Do not interfere with use of property or portions of buildings by authorized persons approved by the Owner. Maintain free and safe passages in and around work areas. Do not seal off required exits without permission from authorities having jurisdiction.

B. Provide, erect and maintain lights, barriers, barricades as necessary to protect life, meeting all Federal, OSHA, State and local laws and regulations.

3.03 UTILITY SERVICES

A. Remove all utility services as required and/or indicated on the Drawings. Provide temporary utilities and services into areas requiring continued services before and after removal work.

B. All electrical equipment and circuits shall be restored to original condition that are damaged or destroyed during removals and are not called out to be removed on the Contract Drawings.

3.04 REMOVALS

A. Before starting demolition work, review all requirements for final remodeling work so that useable existing system components as required for completion of the new work is not destroyed. Coordinate all work with other contractors.

B. Remove any personal property, equipment, machinery, or other fixtures and turn them over to the Owner as called for on the Contract Drawings.

3.05 DEBRIS

A. Remove from the areas of removals, all debris as it accumulates. Do not store or permit debris to accumulate on the site. If the Contractor fails to remove excess debris promptly, the Engineer shall reserve the right to have debris removed by others at Contractor's expense.

B. Upon work completion, remove all tools, materials, equipment, apparatus, temporary toilets, rubbish of every sort. Leave all existing building surfaces, not scheduled to be removed, in broom clean condition at completion of work within any given area. Leave buildings and site clean, neat and orderly.

END OF SECTION

SECTION 26 05 13 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.3 DEFINITIONS

A. Jacket: A continuous nonmetallic outer covering for conductors or cables.

B. NETA ATS: Acceptance Testing Specification.

C. Sheath: A continuous metallic covering for conductors or cables.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable; Prysmian Group North America.
2. Okonite Company (The).
3. Southwire Company.

B. Cable Type: Type MV 105.

C. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: 5 kV.
2. Insulation Thickness: 100 percent insulation level.

D. Conductor: Copper.

E. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74, and ICEA S-97-682.

F. Conductor Stranding: Compact round, concentric lay, Class B.

G. Shielding: Copper tape, helically applied over semiconducting insulation shield.

H. Cable Jacket: Sunlight-resistant PVC.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Adalet.
3. Eaton.
4. nVent (RAYCHEM).

B. Copper-Conductor Connectors: Copper barrel crimped connectors.

2.4 SOLID TERMINATIONS

1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.

B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

C. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.

2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

E. Install terminations at ends of conductors with standard kits.

F. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

G. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.

H. Identify cables according to Section 26 05 53 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
3. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

C. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 05 13

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related Requirements:
   1. General Requirements 01-20-nn thru 01-70-nn.
   2. Electrical Division 26-nn-nn.

1.2 REFERENCES

A. Standard:
   1. ASTM – American Society Testing Materials.
   2. NEMA – National Electrical Manufacturers Association.
   3. NFPA – National Fire Protection Association.
   4. UL – Underwriter Laboratories.

1.03 ACTION SUBMITTALS 01-33-00

A. Product Data:
   1. Submit catalog cuts for products listed.

1.4 CLOSEOUT SUBMITTALS

A. Test Data:
   1. Submit field test results for wires and cables, #2AWG and larger including “Megger” readings with the method used.

1.5 QUALITY ASSURANCE

A. Regulatory:
   1. Electrical Components: Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   2. Comply with NFPA 70.

B. Material:
   1. Wire and cables shall have been manufactured not more than two years prior to installation.
   2. Tapes for splices or terminations shall have been manufactured not more than six months prior to installation.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Conductors/Cables:
   1. Solid Copper ASTM.B3 or B33.
   2. Stranded Copper ASTM B8.
   3. Insulation:
      a. Type “USE-RHH-RHW”, conforming to ASTM D 2802, ICEA S-68-516, UL 44 and UL 854, on cables #1 AWG and larger.
      b. Type THHN/THWN: Heat resistant thermoplastic on Cables #2AWG and smaller.

c. Type XHHW shall be used for Variable Frequency Drive (VFD) motor wires.
d. Insulation or covering wires and cables shall be factory color-coded by the use of colored components or coatings. The color-code shall be followed consistently throughout the performance of the work.

2.2 ASSEMBLIES

A. Wire and Cable – Power:
1. Stranded Copper for #10 AWG and larger.
2. Solid Copper for #12 AWG and smaller.
B. Grounding:
1. Stranded Copper for #8 AWG and larger.
2. Solid Copper for #10 AWG and smaller.
C. Control:
1. Single conductor wires and cables shall be ASTM B8, Class B stranded, 600-volt, sizes as shown on the Contract Drawings, Type THHN/THWN to UL 44 and ICEA S-66-524.
D. Portable Cords: Cords shall conform to UL-62, 600 volt.
1. Type S shall be 60E C rated, with heavy-duty thermosetting insulation and jacket.
2. Type SO shall be oil resistant, 60E C rated, with heavy-duty thermosetting insulation and jacket.
3. Type G or Type W shall be 90E C rated, with ethylene-propylene-rubber insulation and Hypalon jacket, 600-volt rated.

2.3 SPLICES AND TERMINATING DEVICES

All materials for making splices and terminations shall be specifically designed for use with the type of wire or cable, insulation and installation and operating conditions of the specific application.

A. Connectors:
1. Subject to compliance with requirements of this Section, provide connectors of the following types:
a. Solderless, uninsulated, high conductivity, corrosion resistant, compression connectors conforming to UL 467 and IEEE 837.
b. Insulated, indenter type compression butt connectors.
c. Insulated, integral self-locking flexible shell, expandable spring connectors.
d. Uninsulated, indenter type compression pigtail connectors.
e. Welded type connectors:
B. Terminals:
1. Subject to compliance with requirements of this Section, provide terminals of the following types:
a. Solderless, uninsulated, high conductivity, corrosion resistant, compression connectors conforming to UL 467 and IEEE 837.
b. Insulated, compression terminals.
c. Solderless, high conductivity, corrosion resistant, hex screw type, bolted terminals.
d. Welded type terminals.
C. Shrinkable Tubing:
1. Subject to compliance with requirements of this Section, provide shrinkable tubing of the following types:
a. Either irradiated modified polyvinyl chloride or irradiated modified polyolefin heat shrinkable tubing.
b. Cold shrinkable tubing.
D. Tapes and Sealers:
1. Vinyl Tapes shall be flame-retardant, cold and weather-resistant, ¾ inch or 1-1/2 inches wide, as required, and conforming to UL 510 and ASTM D3005.
a. For interior, dry location, provide 7 mils, conforming to ASTM D3005 (Type I); Scotch (3M) No. 33, or approved equal.
b. For exterior or damp and wet locations, provide 8.5 mils, conforming to ASTM D3005 (Tpe II);

Scotch (3M) No. 88, or approved equal.

2. Rubber Tapes shall be ethylene-propylene, rubber-based, 30-mil splicing tape, rated for 130E C operation; ¾ inch and wider conforming to ASTM D1373 and Federal Specification HH-I-553 (Grade A); Scotch (3M) No. 130C, or approved equal.
3. Insulating Putty shall be rubber-based, 125-mil elastic filler putty; 1-1/2 inches wide; Scotch (3M) Scotchfil, or approved equal.
4. Silicone Rubber Tapes shall be inorganic silicone rubber, 12-mil, 130E C rated, anti-tracking, self-fusing tape; 1 inch wide, Scotch (3M) No. 170, or approved equal.
5. Sealer shall be liquid applied, fast-drying sealant; Scotch (3M) Scotchkote, or approved equal.

E. Resin Filled Splices:
1. Epoxy Molded Type:
a. Two-piece, snap-together molded bodies, sized for wire or cable, with two-part low viscosity polyurethane insulating and sealing compound, rated for 600 volts, using crimp-type wire connector; Scotch (3M) No. 87-A1, 87-A2 or 87-A3 compound, or approved equal.
2. Re-Enterable Type:
a. Transparent, molded bodies clamped with stainless steel strain-relief bar and shield continuity connectors, sized for wire or cable, with loosely woven polyester spacer web and jelly-like urethane formulation for permanent re-entry capability; Scotch (3M) No. 78-R1 thru 78-R5, with No. 2144 compound, or approved equal.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prior to pulling wires and cables, clean raceway systems of all foreign matter and perform all operations necessary so as not to cause damage to wires and cables while pulling.

B. Prior to pulling wires and cables into underground conduit systems, place a feeding tube at the entrance end of such systems.

3.2 INSTALLATION

A. Wire and Cable Installation.
1. General:
a. Keep wires and cables dry at all times.
b. Seal wire and cable ends with watertight end seals if splicing or terminating does not follow at once.
c. Before splicing or terminating wires and cables, make a thorough inspection to determine that water has not entered the wires and cables or that the wires and cables have not been damaged.
d. Use adequate lubrication when installing cables in conduits or raceways. Any pulling compounds shall be compatible with the finish of the wires and cables furnished.
2. General Purpose Wires and Cables:
a. For wiring within lighting fixtures only, where sizes #12 AWG shall be used for light and power service.

3. Lighting Fixture Wires:
a. For wiring within lighting fixtures only, where sizes #12 AWG or smaller are required, use Type SF-2 fixture hookup wire. Type SF-2 wire shall not be used for wiring end-to-end connected fluorescent fixtures.
4. Grounding Wires and Cables:
a. Insulated grounding cable shall be of the type specified in this Section and as shown on the Contract Drawings.
b. The use of bare, uninsulated wire and cable shall be only where shown on the Contracting

Drawings.

5. Control Wires and Cables:
   a. Control wires and cables shall not be smaller than #14 AWG unless otherwise shown on the Contract Drawings.

B. Splicing and Terminating:
   1. General Purpose Wires and Cables:
      a. Splices in dry locations for sizes #10 AWG and smaller. Splicing shall be completed using one of the following:
         (1) Insulated, integral, self-locking flexible shell, expandable spring connectors shall be applied to the twisted conductors. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.
         (2) Compression type, insulated butt connectors shall be applied to the butted conductors by means of an appropriate crimping tool, providing controlled indentation. Two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.
         (3) Compression type, pigtail connectors shall be applied to the conductors by means of an appropriate crimping tool, providing controlled indentation. The connector shall be covered with a polyamide cap and two, half-lapped layers of vinyl tape, extending to a distance of not less than one inch from the connector, shall be applied.
      b. Splices in dry locations for sizes #8 AWG and larger. Splicing shall be completed using all of the following:
         (1) Connectors shall be split sleeve solderless type or solderless compression type.
         (2) Fill indents of connectors with Scotchfil.
         (3) Apply rubber splicing tape equal to the original insulation rating.
         (4) Apply two, half-lapped layers of vinyl tape, or a shrinkable tubing.
      c. Splices in Wet Locations:
         (1) Same as dry locations specified above except that after vinyl tape is applied, cover with two coats of sealer or shrinkable tubing.
         (2) Resin-filled splice shall be covered with two, half-lapped layers of vinyl tape and two coats of sealer or shrinkable tubing.
      d. Terminations in dry locations for sizes #10 AWG and smaller shall be compression terminals, insulated or uninsulated.
      e. Terminators in dry locations for sizes #8 AWG through 3/0 AWG shall be either solderless uninsulated compression crimp type ring tongue terminals or bolted hex screw type ring tongue lugs.
      f. Terminations in dry locations for sizes 4/0 AWG and larger shall be solderless, uninsulated compression crimp type ring tongue terminals.
      g. Terminations in wet locations shall be as dry location terminations above, plus cover the entire termination area with two, half-lapped layers of vinyl tape and apply two coats of sealer over the tape.
   2. Portable Cords:
      a. Splices shall not be made in portable cords.
      b. Terminations shall be made only at apparatus to be served or at branch circuit connection by means of any of the following:
         (1) Insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors.
         (2) Insulated, crimp type, compression connectors.
         (3) Uninsulated, ring tongue terminals for connection to wire terminal strip block.
   3. Lighting Fixture Wires:
      a. Connections to branch circuit and to fixture wiring shall be made by either insulated, integral, self-locking flexible shell, expandable spring, or crimp type connectors.
   4. Grounding Wires and Cables:
      a. Splices and terminations shall be installed in accordance with the manufacturer's

recommendations.

5. Control Wires and Cables:
   a. Splices shall be made in accordance with the requirements specified above for general purpose. Where shielded cable is shown on the Contracting Drawings, the shielding shall be continued through the splice. Shields shall be grounded at one location only unless otherwise shown on the Contract Drawings.
   b. Terminations shall be insulated, indenter type ring tongue terminals.

C. Identification of Wires and Cables:
   1. Each wire and cable shall be identified by its circuit in all cabinets, boxes, manholes, handholes, wireways and other enclosures and access locations, and at all terminal points.
   2. The circuit designations shall be as shown on the Contract Drawings. Tags shall be attached to wires and cables in such a manner as to be readily visible.
   3. The tag ties shall be wrapped around all conductors comprising the circuit or feeder to be identified.
   4. Wires and cables which are arcproofed shall also be identified outside the applied arcproofing.

3.3 FIELD TESTS

A. Test all wires and cables larger than #2 installed under this Contract with a 1000-volt Megohmmeter. Furnish the Engineer with a copy of the "Megger" readings together with an outline of the method used. If, in the opinion of the Engineer, any reading is lower than that required by applicable codes, promptly replace the materials involved, at the Contractor's expense, and retest.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Requirements:
   1. Project General Requirement 01-nn-nn.
   2. Electrical Division: 26-nn-nn.
   3. Low Voltage Conductors: 20-05-19.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Associates NFPA.
   2. Underwriter Laboratories UL.

1.03

1.4 ACTION SUBMITTALS 01-33-00

A. Product Data: Submit data for products list.

1.5 CLOSEOUT SUBMITTALS

A. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used. Test results that comply with requirements.
   2. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 QUALITY ASSURANCE

A. Regulatory:
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with UL 467.
   2. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
   3. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated. Raceways shall not be used as equipment grounding conductors.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Equipment Grounding Conductors: Insulated with green-colored insulation.

B. Grounding Electrode Conductors: Stranded cable.

C. Underground Conductors: Bare, stranded, unless otherwise indicated.

2.2 ACCESSORIES

A. Connector Products:
   1. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
   2. Bolted Connectors: Bolted-pressure-type connectors, or compressive type.
   3. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

B. Ground Rods: Copper-clad steel.

PART 3 – EXECUTION

3.1 APPLICATION

A. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

B. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

C. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 INSTALLATION

A. Install equipment grounding conductors with all feeders and branch circuits.

B. Ground Rods:
   1. Install ground rods at engine-generator as indicated.
      a. Drive ground rods until tops are 2 inches below final grade, unless otherwise indicated.
      b. Interconnect ground rods with grounding electrode conductors. Use exothermic welds for all buried or embedded connections. Make connections without exposing steel or damaging copper coating.
   2. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
   3. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Connections:
   1. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
      a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
      b. Make connections with clean, bare metal at points of contact.
      c. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

   2. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
   3. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type

connectors.

4. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
5. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.3 START-UP

A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at the generator location. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
4. Maximum resistance at the generator: 5 ohms.
5. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for hangers, supports, sleeves, fasteners, and equipment pads used to support electrical raceways and equipment.

B. Related Requirements:
1. Project General Requirements 01-nn-nn.
2. Electrical Division 26-nn-nn.

1.2 REFERENCES

A. Definitions:
1. Raceway Support.

B. Reference Standards:
1. ASTM – American Society of Testing Materials.
2. NECA – National Electrical Contractors Association.
3. NFPA – National Fire Protection Association.

1.3 ACTION SUBMITTALS 01-33-00

A. Project Data: Submit the following:
1. Catalog Cuts:
a. Hangers and supports.
b. Sleeves.
c. Fasteners.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Hangers and Supports:
1. Raceway Support:
a. Clevis hangers shall be used for supporting horizontal conduit of galvanized steel, with hole for threaded steel rod.
b. Riser clamps shall be used for supporting vertical conduit of galvanized steel, with 2 or 3 bolts and nuts, and 4-inch ears.
c. C-Clamps shall be black malleable iron or galvanized or plated steel, with hole for threaded steel rod.
d. I-Beam Clamps shall be galvanized or plated steel, 1-1/4 inch x 3/16 inch stock, 3/8 inch cross bolt; 2 inch flange width.
e. Right Angle and Parallel Beam Clamps shall be galvanized steel clamps for supporting or fastening conduit, up to 2 inch trade size.
f. Two-Hole Conduit Straps shall be used for supporting conduit larger than 1 inch, of galvanized steel ¾ inch strap width.
g. Hexagon Nuts shall be galvanized steel.
h. Round Steel Rod shall be galvanized or plated steel, threaded.
i. The following types of hangers and supports shall not be used.
1) Perforated metal strapping;
2) Slotted, perforated angles;
3) Spring pressure or torsion clips, hangers, or supports.

2. Equipment Supports:
   a. Electrical channel strut system shall be 12-gauge, hot-dipped galvanized steel. Provide with drilled or slotted holes as required with the following fittings which are designed and manufactured for use with electrical channel.
      1) Fixture, conduit, and channel hangers.
      2) End caps.
      3) Beam clamps.
      4) Wiring stud.
      5) Conduit clamps.
      6) U-bolts.
   b. Electrical channel strut system shall be as manufactured by Unistrut, B-Line Systems Inc., or equal.
3. Supporting Steel Sections and Channels:
   a. Supporting steel sections and channels shall be fabricated of ASTM A1008 steel in accordance with the appropriate requirements of the AISC, AISI, and AWS publications specified in 1.02, and shall be hot-dipped galvanized after fabrication.

B. Sleeves and Seals:
1. Pipe Sleeves:
   a. Provide pipe sleeves for conduits penetrating concrete or masonry floor and walls, as follows:
      1) Steel pipe sleeves shall be fabricated from Schedule 40, galvanized steel pipe, remove burrs.
      2) Iron pipe sleeves shall be fabricated from cast iron or ductile iron pipe, remove burrs.
      3) Plastic pipe shall be fabricated from Schedule 40, PVC plastic pipe, remove burrs. PVC sleeves shall be utilized for exterior usages only.
2. Interlocking Modular Seals (Link-Seal):
   a. Provide interlocking modular type seals for conduit access located in exterior foundation and pit walls. The seals shall be multi-link, stainless steel bolted connection, high-temperature fittings. Thunderline Corporation “Link-Seal”, or equal.
3. Sealing Bushings:
   a. Provide sealing bushings for conduit access core-drilled through foundation walls or floors. The bushings shall be molded, one-piece neoprene sealing rings with PVC coated steel or uncoated aluminum pressure plates, stainless steel hex socket head cap screws and flat washers, O.Z. Gedney Co. Series ‘CSM’, or equal.
4. Fire Seals:
   a. Provide UL listed, 3 hour rating, silicone based foam, fire resistive, water proof joint sealing system to prevent the passage of hot gasses and fire.
5. Wall and Floor Seals:
   a. Provide watertight and pressure-tight wall and floor seals suitable for sealing around conduit passing through exterior concrete floors and walls. Assembly shall include steel sleeves, galvanized malleable iron body, neoprene sealing grommets and rings, metal pressure rings, membrane clamp where required by foundation design and pressure clamps with Type 316 stainless steel cap screws, O.Z. Gedney Co. Type WSK/MC, or equal.

C. Fasteners:
1. General:
   a. Provide fasteners as specified below, unless otherwise shown on the Contract Drawings.
   b. Where more than one type of fastener is suitable for the intended use, selection is at the Contractor’s option, subject to approval by the Engineer.
2. Toggle Bolts shall be springhead, galvanized or plated steel, ¼ inch to ½ inch sizes, length as required.
3. Expansion Anchors shall be metallic expansion anchors or shields, including drop-in anchors, wedge and sleeve anchors, and two-piece and three piece shields for lag screws or machine screws or bolts.
4. Bolts, Nuts, Lock Washers, and Washers:

a. All hardware shall be galvanized or plated steel, unless otherwise shown on the Contract Drawings.
b. Bolts and nuts, ¼ inch trade size and larger, shall be hex head or hex socket type, standard American sizes.
c. Lock washers shall match the finish of the furnished bolts and nuts, and generally be installed one-per-bolt, at the nut end of the assembly.
d. Washers shall be standard or fender type, as required, and sized to match the installed bolts or s screws.

5. The following types of fasteners shall not be used:
a. Lead anchors or studs;
b. Wooden plugs or anchors;
c. Plastic anchors;
d. "Nail-in" anchors, either of the plastic or metal type.

2.2 MIXES

A. Concrete:
1. Concrete shall be 3500 psi 3.5N (5.5 sack/cyd).

PART 3 – EXECUTION

3.01 INSTALLATION

A. General:
1. Install hangers and supports, sleeves and fasteners in accordance with the manufacturer's written recommendations.
2. Coordinate all affected trades and all aspects of the electrical work, including installation of raceways and wiring as necessary to interface installation of supporting devices with other work.
3. Install hangers and supports, and attachments to properly support raceways, equipment and accessories from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze hangers where possible. Install hangers and supports with maximum spacings not to exceed that permitted by NFPA 70 and NECA 5055, as applicable.
4. Secure threaded rod couplings, trapeze hangers or supports or similar horizontal elements, using lockwashers and jam nuts to prevent loosening.

B. Conduit and Raceway Supports:
1. Raceways shall not be supported from hung ceiling supports or members, or the metal roof deck.
2. Raceways shall not be supported from mechanical ductwork, ductwork supports, piping or piping supports.
3. Threaded rod, for the support of conduits, raceways or trapeze hangers of the given size, shall not be less than the following:

Conduit, Raceway, Hanger Size (inches)	Threaded Rod Size (inches)
2 or less	3
2 ½ - 3	1/2
4 – 5	5/8
6	3/4

4. Where trapeze hangers are used, bolt or clamp the raceways in place to at least every third hanger and to the first hanger on each side of a bend, fitting, junction or pull box or change in direction.

C. Sleeves:
1. Extend sleeves for raceways and risers one inch beyond top of finished floor, curb or building element being penetrated.
2. Install sleeves level and plumb, accurately located and positioned to conform to the requirements of the equipment and in accordance with the approved layout drawings.
3. Install interlocking modular seals in tandem, one at the interior and one at the exterior face of the pipe sleeve.
4. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

D. Fasteners:
1. Wood screws, lag screws, carriage bolts or machine screws shall be utilized for wood or materials of similar fibrous nature.
2. Welded or brazed threaded studs, bolts or machine screws or clamps shall be utilized for structural and miscellaneous steel, iron or other metals.
3. Metallic expansion shields, wedge anchors or drop-in anchors, with lag screws, bolts or machine screws shall be utilized for solid masonry or concrete.
4. Sleeve anchors, drop-in anchors or toggle bolts shall be utilized for concrete masonry units (CMU). Power activated fasteners shall not be used in CMU.

E. Equipment Pads:
1. All switchboards, transformers and like equipment shown as floor mounted to be installed upon concrete bases up 4” high above the floor with edges chamfered and all surfaces troweled smooth.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for raceways, fittings, boxes and enclosures for electrical wiring.
B. Related Requirements:
   1. Project General Requirements Division: 01-nn-nn.
   2. Process Division 40-nn-nn.

1.2 REFERENCES

A. Abbreviation:
   1. Rigid Galvanized Steel (RGS).
   2. Electrical Metallic Tubing (EMT)
   3. Flexible Metal Conduit (FMC)
   4. Liquidtight Flexible Metal Conduit (LMC)
   5. Polyvinyl Chloride (PVC).
B. Reference Standards:
   1. ANSI – American National Standards Institute.
   2. NEMA – National Electrical Manufacturers Association.
   3. NFPA – National Fire Protection Association.
   4. UL – Underwriters Laboratory.

1.3 ADMINSTRATIVE REQUIREMENT

A. Coordination:
   1. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures and HVAC equipment. Locate and install boxes so as to maintain accessibility after installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings:
   1. Specialized conduit fittings and transitions (i.e., transition to explosion proof fitting).
   2 Surface Raceways.
B. Catalog Cuts:
   1. Conduit and Tubing:
   2. Surface Raceways and Accessories.
   3. Conduit Bodies and Fittings.
   4. Wireways and Auxiliary Gutters.

1.5 QUALITY ASSURANCE

A. Work shall be performed in a neat and workmanlike manner in accordance with the requirements of the National Electric Code: NFPA 70.
B. Products shall be UL listed:
   1. UL 1: Flexible Metal Conduit.
   2. UL 5: Surface Metal Raceways and Fittings.
   3. UL 6: Rigid Metal Conduit.
   4. UL 360: Electrical Liquid-tight Flexible Steel Conduit.
   5. UL 514B: Fittings for Conduit and Outlet Boxes.
   6. UL 797: Electrical Metallic Tubing.
   7. UL 870: Wireways, Auxiliary Gutters, and Associated Fittings.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Metal Conduit:
1. RGS – Rigid Galvanized Steel:
a. Hot-dipped galvanized steel (thick-wall) conduit shall be threaded and conform to UL 6 and ANSI C80.1.
2. EMT – Electrical Metallic Tubing:
a. Galvanized steel (thin-wall) conduit shall conform to UL 797 and ANSI C80.3.
3. FMC – Flexible Metal Conduit:
a. Galvanized steel (flexible) conduit shall conform to UL.1.
4. LMC – Liquid tight Flexible Metal Conduit:
a. Galvanized steel (flexible) conduit with liquid tight, non-metallic, sunlight resistant outer jacket shall conform to UL 360.

B. Non-Metallic Conduit:
1. PVC – Polyvinyl Chloride Conduit NEMA TC-2.
a. Schedule 40 (thin wall).
b. Schedule 80 (thick wall).

2.2 BOXES

A. General:
1. Locations, types and sizes of boxes shall be shown on the Contract Drawings.
2. Unless otherwise shown on the Contract Drawings, boxes and fittings shall be metallic and shall conform to NEMA 0S1, NEMA 250, UL 50, UL 514A, UL 514B, and NFPA 70.
3. Nonmetallic boxes shown on the Contract Drawings shall conform to NEMA 0S2, NEMA 250, UL 50, UL 514C, and NFPA 70.
4. Boxes to be located in hazardous (classified) areas, as shown on the Contract Drawings, shall conform to UL 886 and NFPA 70.
5. Where the dimensions of a box are not shown on the Contract Drawings, boxes whether for power or other purposes, shall be sized as follows:
a. On straight pulls, the length of the box shall not be less than 8 times the trade diameter of the largest raceway.
b. Where angle or "U" pulls are made, the distance between each raceway entry inside the box and the opposite wall of the box shall not be less than 6 times the trade diameter of the largest raceway. The distance shall be increased for additional entries by the amount of the sum of the diameters of all other raceway entries in any row on the same wall of the box. The distance between raceway entries enclosing the same conductor shall not be less than 6 times the trade diameter of the larger raceway.
c. The minimum depth of a box shall be not less than two times the trade diameter of the conduit entries in a single row and not less than 1-1/2 times the sum of the trade diameter of the largest raceway in each row for multiple rows.
6. Weatherproof cast boxes shall be used for exterior or damp locations. Weatherproof boxes shall be hot-dipped galvanized cast-steel or cast-aluminum. Cast boxes shall be threaded conduit entrance type provided with mounting lugs. Materials shall match the type of conduit i.e., galvanized steel or aluminum, used in the conduit run.

B. Outlet Boxes:
1. Interior Boxes:

a. Provide galvanized, flat-rolled, sheet-steel interior outlet wiring boxes, of types, shapes, and sizes, including box depths, to suit each respective location and installation; construct boxes with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.
b. Outlet boxes shall be of proper sizes and shapes for conduits and wires entering them, and equipped with plaster ring or cover as necessary for the wiring devices to be installed.
c. Boxes for switches and receptacles shall be 4-inch square, minimum 2-1/8 inch deep, for up to two devices; solid, ganged boxes for over two devices; and installed so that device covers shall be tight and plumb with wall finish.
d. Provide suitable barrier in boxes where two or more 277-volt switches are to be installed, to isolate each on its own phase.
e. Boxes for lighting fixture installation shall be 4-inch square, minimum 2-1/8 inch deep, and provided with 3/8 inch studs.
f. Boxes to be installed in ceilings, plenums, or spaces used for supply or return of environmental air shall be UL listed for use, without holes, openings or penetrations, and complete with gasketed cover plates.
g. Provide all sheet-steel boxes with suitable knockouts.

2. Exterior Boxes:
a. Provide corrosion-resistant, cast-metal, weatherproof outlet wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation.
b. For outlet boxes to be installed flush or recessed in exterior walls, provide galvanized, sheet-steel boxes, with suitable depth and tile, plaster or masonry rings for the wall construction.
c. Provide cast-metal face plates with spring-hinged, waterproof caps suitably configured for each application, including face plate gaskets and stainless steel or brass screws or fasteners. Face plate material shall match the type of box i.e., galvanized steel or aluminum.

C. Junction and Pull Boxes:
1. General:
a. Unless otherwise shown on the Contract Drawings, provide galvanized, code-gauge, sheet-steel junction and pull boxes and covers for interior locations and cast-metal boxes and covers for exterior locations of types, shapes and sizes to suit each respective location and installation, and equipped with stainless steel hinges, nuts, bolts, screws and washers.
b. Junction or pull boxes having any dimension larger than 36 inches shall contain racks or supports for all cables or conductors.
c. Provide pull boxes with suitable insulating barriers where shown on the Contract Drawings or required by code. Vertical-offset pull boxes shall contain cable supports at turns to prevent cables from resting on corners.
d. All covers in exposed exterior locations, or other areas as shown on the Contract Drawings, shall be gasketed.
e. For covers heavier than 20 pounds or more than 24 inches in any dimension, provide two replaceable studs, located on each side of the box flange, to support the cover during installation.

2. Interior
a. Boxes in finished areas having any cover dimension 12-inches or less shall be furnished with flush-mounting, screw-on covers, unless otherwise shown on the Contract Drawings.
b. Boxes located in electrical or telephone closets or rooms, in mechanical

3. Exterior:
a. Boxes located in finished areas such as sidewalks and decks shall be furnished with flush-mounting, screw-on covers.
1) Boxes having any cover dimension 24 inches or less shall be furnished with flush-mounting, screw-on covers.

2) Covers having any dimension larger than 24 inches shall be cast-steel “sidewalk” frames and covers, suitable for installation on a concrete box or handhole.
b. Unfinished Areas: Boxes located in areas unfinished shall be furnished with screw-on covers for

boxes having any cover dimension 24 inches or less, and with hinged, bolt-on covers for boxes having any cover dimension larger than 24 inches.

PART 3 – EXECUTION

3.1 RACEWAY INSTALLATION

A. General:
1. Raceways shall be installed in accordance with manufacturer's written recommendations and the NEC.
2. All bends shall be made in accordance with manufacturer's ratings and the NEC.
3. Conduit ends shall be reamed free from burrs prior to installation and draw joints shall be drawn up tight.
4. Care shall be taken to prevent the entrance of foreign matter in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely free of obstructions, or be replaced. Caps shall be placed on the ends of conduit runs as soon as they are located to prevent intrusion of foreign materials.
5. Raceways shall be concealed wherever possible within finished walls, ceilings and floors. Raceways shall be installed not less than six (6) inches from parallel runs of flues, steam pipes and water pipes.
6. Where raceways are required to be exposed, they shall be:
   a. Located above hung or accessible ceilings.
   b. Parallel with or at tight angles to the lines of structure.
   c. As close to the structure as possible.
7. Expansion fittings shall be installed in all conduits which cross-expansion joints or where conduits attach to independent structures.
8. Threaded conduits entering sheet metal-type enclosures shall be secured by means of two lock-nuts, one on each side of the enclosure. The conduits shall be terminated in insulated bushings.
9. All openings created for conduit penetration of roofs, external building wells and manholes shall be sealed with appropriate waterproof sealing material.
10. All interior raceway systems that are exposed to widely different temperatures such as walk-in cooler or penetration of exterior wall shall be provided with a raceway seal and the gaps caulked with silicone sealant.
11. All conduits shall be supported with spacing intervals not less than those specified in the NEC. Supports shall prevent sagging of the conduits.
12. All conduit runs shall leave or enter structures perpendicularly.
13. All raceway attachment hardware shall be installed to ensure conduits are securely fastened prior to cable installation.
14. Arrange conduit to maintain headroom and present neat appearance.
15. Do not cross conduits in slab.
16. Maintain adequate clearance between conduit and piping.
17. Cut conduit square using saw or pipecutter.
18. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
19. Provide nylon pull string in each empty conduit except sleeves and nipples.
20. Ground and bond conduit.
21. Route conduit in and under slab from point-to-point.

B. RGS shall be installed:
1. Where shown on the Contract Drawings.
2. In areas classified by the NEC as hazardous.
3. In mechanical and electrical rooms and locations where physical abuse is probable.

4. Underneath slab-on grade. Raceway shall be not less than 6" below bottom of slab.

C. EMT shall be installed:
1. Where shown on the Contract Drawings.
2. For power feeders, branch circuits and in concealed locations.
3. For the distribution of other systems, including, but not limited to, fire alarm, telephone/data, nurse call and paging.

D. FMC shall be installed:
1. In interior, dry locations for motor connections and for other equipment connections subject to movement and vibration. Conduit shall be installed to permit maximum flexibility, without crushing or permanent deformation. Conduit shall be no greater than 36 inches in length.
2. With a separate, insulated copper equipment grounding conductor.

E. LMC shall be installed as per FMC for locations other than both interior or dry.

F. PVC shall be installed:
1. In concrete encased duct banks or directly buried, as shown on the Contract Drawings.
2. Using cement for joints as recommended by manufacturer. Wipe conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for not less than 20 minutes.
3. Where a PVC conduit run turns up to exit the slab, a RGS sweep shall be used.

G. Surface Raceways:
1. Unless otherwise shown on the Contract Drawings, only metallic surface metal raceways shall be permitted. Installation shall be in accordance with manufacturer's written recommendations.
2. Provide surface raceway system with means for assuring a continuous ground path throughout.
3. Use fittings without sharp edges introduced into any part of the raceway system.
4. Fasten raceway channel to surfaces in accordance with Section 26-05-29. Mount plumb and level.
5. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
6. Wireway Supports: Provide steel channel as specified in Section 26-05-29.
7. Close ends of wireway and unused conduit openings.

3.2 INSTALLATION BOXES

A. Install boxes at the locations shown on the Contract Drawings and as required by NFPA 70 at any other location where they are required to facilitate the pulling, supporting or connection of wires and cables.

B. Securely mount all boxes in a manner approved by the Engineer and support the boxes independently of conduits entering them.

C. Install boxes in classified (hazardous) locations in accordance with their listing or label requirements. Conduit seal fittings shall be packed and filled only after proper operation of equipment and systems has been demonstrated and approved by the Engineer.

3.3 FIELD TESTS

A. Conduit Cleaning and Testing:
1. After installation of conduits and accessories and completion of all concreting operations, if any, carefully clean and clear all conduit runs of all obstructions and foreign matter.
2. Test conduits by pulling through each conduit a flexible cylindrical mandrel having an outside diameter not more than ¼ inch smaller than the inside diameter of the conduit, but nominally 85 percent of the trade diameter, whichever is larger. Only nylon cable of adequate strength shall be used to pull the mandrel through the conduit system. Rope shall not be used.

B. Connections to Existing Conduits:
1. Where conduits installed under this contract are connected to existing conduits, or conduits installed by others, test the entire run to the nearest box, manhole, handhole, or equipment enclosure as specified above.
2. Report immediately any defect or stoppage found in portions of the conduit system not installed under this contract. The Contractor's compensation for the rectifying of such defects or stoppages will be determined

in accordance with the clause of the Contract providing compensation for Extra Work.

3. Perform all test required by these specifications in order to provide data as to the acceptability of any raceway damage.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies materials and requirements for marking/identifying electrical raceways and devices.

1.2 QUALITY ASSURANCE

A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cable/Conductors:
   1. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
   2. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
   3. Cable Tags: Semi-rigid yellow polyethylene, with ½" black die-cut self adhesive letters and numerals, and clear vinyl self-adhesive laminate covering for strap-on installation using self-locking nylon cable ties. Apply to exposed lengths of 5-kV cable circuits where entering or leaving underground ducts in manholes, inside pull boxes of exposed conduit runs, and at equipment terminations.
   4. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
   5. Stainless Steel Tags: 28ga, ¾ inch high walls, 5/16 inch high lettering.

B. Electrical Cabinets and Enclosures:
   1. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
   2. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
      a) Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
   3. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

PART 3 – EXECUTION

3.01 IDENTIFICATION MATERIALS AND DEVICES

A. Installation:
   1. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
   2. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
   3. Self-Adhesive Identification Products: Clean surfaces before applying.
   4. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

B. Signage:

1. Install warning, caution, and instruction signs where required to comply with 29 CFR 1910.145, Chapter XVII, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Indoors install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

END OF SECTION

SECTION 26 05 73.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.

2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

    a. Short-circuit study input data, including completed computer program input data sheets.
    b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

        1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
        2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:

    a. Final one-line diagram.
    b. Final Short-Circuit Study Report.
    c. Short-circuit study data files.
    d. Power system data.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

F. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. Power Analytics, Corporation.
5. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 01 78 39 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 26 05 73.13

SECTION 26 05 73.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals [**shall**] [**may**] be in digital form.

    a. Coordination-study input data, including completed computer program input data sheets.
    b. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:

    a. Final one-line diagram.
    b. Final protective device coordination study.
    c. Coordination study data files.
    d. List of all protective device settings.
    e. Time-current coordination curves.
    f. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. Power Analytics, Corporation.
5. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Any revisions to electrical equipment required by the study.
7. Study Input Data: As described in "Power System Data" Article.

a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.
2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, and ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.
b. Medium-voltage equipment overcurrent relays.
c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 26 05 73.16

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
2. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 05 73.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 73.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 05 73.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Retain one or more of three subparagraphs below. 85 percent of maximum is IEEE-recommended level for a second short-circuit value. NFPA 70E states that 38 percent of maximum is the lowest sustaining arcing current and that it creates the highest arcing energy. Some clients and engineers request the calculation at minimum short circuit to prolong the clearing time of the protective device.
3. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
4. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
5. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short circuit current at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.

13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Medium voltage transformers
6. Low voltage transformers.
7. Panelboard and safety switch over 250 V.
8. Applicable panelboard and safety switch under 250 V.
9. Control panel.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 26 05 73.19

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements for electrical panelboards.
B. The types of panelboards specified in the Section are:
   1. Lighting and appliance panelboards

1.2 REFERENCES

A. The following is a listing of the publications referenced in this Section:

National Electrical Manufacturers Association (NEMA)

NEMA PB 1	Panelboards
NEMA PB 1.1	Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

National Fire Protection Associates (NFPA)

NFPA 70	National Electrical Code (NEC)

Underwriters Laboratories Inc. (UL)

UL 50	Boxes and Cabinets
UL 67	Panelboards
UL 98	Enclosed and Deadfront Switches
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

A. The panelboards and associated materials shall conform to all applicable standards, to the requirements specified herein, and as shown on the Contract Drawings.
B. Panelboard cabinets shall meet the following requirements, unless otherwise noted.
   1. Cabinets to be installed in interior areas shall be type NEMA 12.
   2. Cabinets to be installed in exterior areas subject to rain shall be NEMA 3R.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Panelboards shall be delivered to the site as a complete assembly. All electrical devices shall be installed and connected. Components shall be packaged to prevent damage due to vibration and jarring during transportation and handling.
B. Devices shipped loose shall be delivered in the manufacturer's original, unopened, protective packaging and shall be identified with suitable non-corrosive tags.
C. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of the final cleanup.

1.5 SUBMITTALS (01-33-00)

A. Shop Drawings
   1. Shop Drawings shall contain overall panel dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches and solid neutral, shall be clearly shown. One line diagrams shall illustrate with applicable voltage systems.
   2. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 (Operations and Maintenance Manual) with each panelboard.

1.6 WARRANTY

A. Panelboards shall warranted to be free from defects in materials and workmanship by the manufacturer for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirement of this Section, provide panelboards of one of the following manufacturers:
   1. Square D Company
   2. General Electric Company
   3. Matching existing manufacturer where panel board is being expanded.
   4. No substitutions.

2.2 GENERAL

A. The type of panelboard (lighting and appliance or distribution) shall be as shown on the Contract Drawings.
B. The size, rating and number of circuit breakers in each panelboard shall be as shown on the Contract Drawings.
C. Location of panelboards shall be as shown on the Contract Drawings.
D. All panelboards shall bear the UL label.

2.3 LIGHTING AND APPLIANCE PANELBOARD

A. Operating voltage, phase, wire, current, and short circuit rating shall be as shown on the Contract Drawings.
B. Construction features shall be:
   1. Interior
      a. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be copper. Panelboards shall be suitable for use as Service Entrance Equipment when application requirements comply with UL 67 and NEC Articles 230-F and G.
      b. All current carrying parts shall be insulated from ground and phase-to-phase by Noryl high dielectric strength thermoplastic or equivalent.
      c. Where 200% rated neutrals are shown on the Contract Drawings, they shall be solid neutral shall be self-certified by manufacturer.
      d. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.

e. Metal nameplates shall be secured to dead-front with rivets or screws. Sticker or foil nameplates are not permitted. Interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating shall be displayed on the interior.

f. Interiors shall be field convertible for top or bottom incoming feed. Main and sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

g. Cabinets with through wiring shall be arranged to provide side gutters not less than 4 inches wide. Cabinets shall be provided with 6-inch wide top and bottom gutters at conduit entry locations. Where conductor size exceeds #4/0, gutter width shall be not less than 6 inches. Where feeder cables supplying the mains of a panelboard are carried through its box to other panelboards, the cabinet shall be provided with adequate additional side gutter space for the riser cable and taps.

h. Main and branch circuit bus shall be copper, based on 1,000 amperes per square inch current density, and contact surfaces shall be based on not more than 200 amperes per square inch current density.

2. Main Circuit Breaker and Branch Circuit Breakers

a. Main circuit breaker and branch circuit breakers shall be in conformance with the requirements of Section 26-28-01 - Overcurrent Protective Device.

b. Main circuit breaker and branch circuit breakers shall be of the same manufacturer as the panelboard.

3. Enclosure

a. Type 1 Boxes

1. Shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanealed steel will not be acceptable.

2. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.

3. Box width shall be 20" wide, unless otherwise shown on the Contract Drawings.

b. Type 1 Trim Fronts

1. Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

2. Trim fronts shall be 1-piece with door. Mounting shall be flush or surface as shown on the Contract Drawings.

3. Panelboards rated 225 amperes and below shall have flat fronts with concealed door hinges and trim screws. Front is not removable with the door locked. Panelboards rated above 225 amperes shall have fronts with trim clamps and concealed door hinges. Trim front doors shall have rounded corners and edges shall be free of burrs.

4. Front shall have cylindrical tumbler type lock with catch and spring loaded stainless steel door pull. all lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic director card holder shall be mounted on the inside of door.

c. Type 3R and 12

1. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

2. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional trunk latches. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.
3. Maximum enclosure dimensions shall not exceed 20" wide and 6.5" deep.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Panelboards shall be installed with tops 6 feet-6 inches above the floor, unless otherwise noted.
B. Panelboards shall be installed true and plumb using supports and fasteners as specified in Section 26-05-29 Hangers and Supports.
C. Cables shall be neatly racked and bundled with nonflammable nylon ties, routed and supported within the gutters. Minimum bending radii as recommended by cable manufacturers shall not be reduced.
D. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NFPA 70 standards.
E. Provide engraved laminated nameplates.

3.2 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
C. Check tightness of bolted connections, and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION

SECTION 26 12 19 - PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.3 DEFINITIONS

A. BIL: Basic Impulse Insulation Level.

B. Bushing: An insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

C. Bushing Elbow: An insulated device used to connect insulated conductors to separable insulated connectors on dead-front, pad-mounted transformers and to provide a fully insulated connection. This is also called an "elbow connector."

D. Bushing Insert: That component of a separable insulated connector that is inserted into a bushing well to complete a dead-front, load break or non-load break, separable insulated connector (bushing).

E. Bushing Well: A component of a separable insulated connector, either permanently welded or clamped to an enclosure wall or barrier, having a cavity that receives a replaceable component (bushing insert) to complete the separable insulated connector (bushing).

F. Elbow Connector: See "bushing elbow" above.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pad-mounted, liquid-filled, medium-voltage transformers.

1. Include plans and elevations showing major components and features.

a. Include a plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.

2. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include single-line diagram.
4. Include list of materials.
5. Include nameplate data.
6. Manufacturer's published time-current curves of the transformer high-voltage fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Certificates: For transformers, signed by product manufacturer.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2.

C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

A. Windings Material: Aluminum.

B. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into the inserts provided in the high-voltage section of the transformer. Connected in each phase of incoming circuit and ahead of any disconnecting device.

C. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.

D. Efficiency: Comply with 10 CFR 431, Subpart K.

E. Insulation: Transformer kVA rating shall be as follows: The average winding temperature rise above a 30 deg C ambient temperature shall not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.

F. Tap Changer: External handle, for de-energized operation.

G. Tank: Sealed, with welded-on cover. Designed to withstand internal pressure of not less than 7 psi (50 kPa) without permanent distortion and 15 psig (104 kPa) without rupture. Comply with IEEE C57.12.36.

H. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to the public.

I. Mounting: An integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.

J. Insulating Liquids:

1. Less-Flammable Liquids:

a. Edible-Seed-Oil-Based Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92. Liquid shall be biodegradable and nontoxic, having passed the Organization for Economic Co-operation and Development G.L.203 with zero mortality, and shall be certified by the U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
b. Biodegradable and Nontoxic Dielectric: Listed and labeled by an NRTL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D92.

K. Sound level shall comply with NEMA TR 1 requirements.

L. Corrosion Protection:

1. Transformer coating system shall be factory applied, complying with requirements of IEEE C57.12.29, in manufacturer's standard color green.

2.3 THREE-PHASE TRANSFORMERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Power Grids Division.
2. Eaton.
3. GE Power; General Electric Company.
4. Schneider Electric.

B. Description:

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with IEEE C57.12.26.

C. Compartment Construction:

1. Double-Compartment Construction: Individual compartments for high- and low-voltage sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with a stop in the open position and provision for padlocking.

D. Primary Fusing: Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.

1. 150-kV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
2. Interrupting Rating: 50,000 rms A symmetrical at system voltage.
3. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse shall sense both high currents and high oil temperature to provide thermal protection to the transformer.
4. Provide bayonet fuse assembly with an oil retention valve and an external drip shield inside the housing to eliminate or minimize oil spills. Valve shall close when fuse holder is removed and an external drip shield is installed.
5. Provide a conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.

E. High-Voltage Section: Dead-front design.

1. To connect primary cable, use separable insulated connectors; coordinated with and complying with requirements of Section 26 05 13 "Medium-Voltage Cables." Bushings shall be one-piece units, with ampere and BIL ratings the same as connectors.
2. Bushing inserts:

    a. Conform to the requirements of IEEE 386.
    b. Rated at 200 A, with voltage class matching connectors. Provide a parking stand near each bushing well.
    c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts.

3. Access to liquid-immersed fuses.
4. Dead-front surge arresters.
5. Tap-changer operator.
6. Ground pad.

F. Low-Voltage Section:

1. Bushings with spade terminals drilled for terminating the number of conductors indicated on the Drawings, and the lugs that comply with requirements of Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

G. Capacities and Characteristics:

1. Power Rating (kVA):1000.
2. Voltage Ratings: 2400 V - 480Y/277 V.
3. Full Capacity Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated high voltage.
4. Transformer BIL (kV): 60.

5. Minimum Tested Impedance (Percent at 85 deg C): 5.75.
6. Comply with FM Global Class No. 3990.
7. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.

H. Transformer Accessories:

1. Drain and filter connection.
2. Filling and top filter press connections.
3. Pressure-vacuum gauge.
4. Dial-type analog thermometer with alarm contacts.
5. Magnetic liquid level indicator with high and low alarm contacts.
6. Automatically resetting pressure-relief device. Device flow shall be as recommended by manufacturer. With alarm contacts and a manual bleeder.
7. Stainless-steel ground connection pads.
8. Machine-engraved nameplate, made of anodized aluminum or stainless steel.
9. Sudden pressure relay for remote alarm or trip when internal transformer pressure rises at field-set rate. Provide without seal-in delay.

2.4 SERVICE CONDITIONS

A. Transformers shall be suitable for operation under service conditions specified as usual service conditions in IEEE C57.12.00.

2.5 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."

1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s). Sign legend shall be "DANGER HIGH VOLTAGE" printed in two lines of nominal 2-inch-high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.
2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

2.6 SOURCE QUALITY CONTROL

A. Provide manufacturer's certificate that the transformer design tests comply with IEEE C57.12.90.

1. Perform the following factory-certified routine tests on each transformer for this Project:

a. Resistance.
b. Turns ratio, polarity, and phase relation.
c. Transformer no-load losses and excitation current at 100 percent of ratings.
d. Transformer impedance voltage and load loss.
e. Operation of all devices.
f. Lightning impulse.
g. Low frequency.
h. Leak.

i. Impedance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pad-mounted, liquid-filled, medium-voltage transformers upon delivery.

1. Upon delivery of transformers and prior to unloading, inspect equipment for any damage that may have occurred during shipment or storage.
2. Verify that tie rods and chains are undamaged and tight, and that all blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on high- or low-voltage bushing parts, and at transformer base.
5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge; it is required to read other than zero.
6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
7. Verify presence of polychlorinated biphenyl content labeling.
8. Unload transformers carefully, observing all packing label warnings and handling instructions.
9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use all lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with a crane.
8. Use spreaders or a lifting beam to obtain a vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

1. Store transformers in accordance with manufacturer's recommendations.

2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
4. Store transformers with compartment doors closed.
5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions. Verify that an effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.

D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.

E. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.

F. Examine concrete bases for suitable conditions for transformer installation.

G. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.
2. Remove a sample of insulating liquid according to ASTM D923. Insulating-liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:

a. Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.
b. Acid Neutralization Number: ASTM D974.
c. Interfacial Tension: ASTM D971.
d. Color: ASTM D1500.
e. Visual Condition: ASTM D1524.

H. Verify that ground connections are in place and that requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 1 ohm at transformer location.

I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Transformer shall be installed level and plumb and shall tilt less than 1.5 degrees while energized.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and IEEE C2.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

1. For counterpoise, use tinned bare copper cable not smaller than No. 4/0 AWG, buried not less than 30 inches below grade interconnecting the grounding electrodes. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors, sized as shown. Keep lead lengths as short as practicable, with no kinks or sharp bends.
2. Make joints in grounding conductors and loops by exothermic weld or compression connector.
3. Terminate all grounding and bonding conductors on a common equipment grounding terminal on transformer enclosure.
4. Complete transformer tank grounding and lightning arrester connections prior to making any other electrical connections.

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.

C. Terminate medium-voltage cables in incoming section of transformers according to Section 26 05 13 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

A. Comply with installation requirements for labels and signs specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. General Field-Testing Requirements:

    a. Comply with provisions of NFPA 70B Ch. "Testing and Test Methods."
    b. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
    c. After installing transformer but before primary is energized, verify that grounding system at the transformer is tested at specified value or less.
    d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
    e. Visual and Mechanical Inspection:

        1) Verify equipment nameplate data complies with Contract Documents.
        2) Inspect bolted electrical connections for high resistance using one of the following two methods:

a) Use a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.

f. Remove and replace malfunctioning units and retest.
g. Prepare test and inspection reports. Record as-left set points of all adjustable devices.

2. Medium-Voltage Surge Arrester Field Tests:

a. Visual and Mechanical Inspection:

1) Inspect physical and mechanical condition.
2) Verify arresters are clean.
3) Verify that ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical Test:

1) Perform an insulation-resistance test on each arrester, phase terminal-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.
2) Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.

3. Liquid-Filled Transformer Field Tests:

a. Visual and Mechanical Inspection:

1) Test dew point of tank gases if applicable.
2) Inspect anchorage, alignment, and grounding.
3) Verify bushings are clean.
4) Verify that alarm, control, and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
5) Verify that liquid level in tanks is within manufacturer's published tolerances.
6) Perform specific inspections and mechanical tests recommended by manufacturer.
7) Verify presence of transformer surge arresters and that their ratings are as specified.
8) Verify that as-left tap connections are as specified.

b. Electrical Tests:

1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.
2) Perform power-factor or dissipation-factor tests on all windings according to test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.3.

3) Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.
4) Measure resistance of each winding at each tap connection, and record temperature-corrected winding-resistance values in the Operations and Maintenance Manual.
5) Perform an applied-voltage test on high- and low-voltage windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9.
6) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
7) Remove a sample of insulating liquid according to ASTM D923, and perform dissolved-gas analysis according to IEEE C57.104 or ASTM D3612.

3.6 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: After Substantial Completion, if requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each transformer. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during test period, is unacceptable.
2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:

    a. Adjust transformer taps.
    b. Prepare written request for voltage adjustment by electric utility.

3. Retests: Repeat monitoring, after corrective action is performed, until satisfactory results are obtained.
4. Report:

    a. Prepare a written report covering monitoring performed and corrective action taken.

B. Infrared Inspection: Perform survey during periods of maximum possible loading. Remove all necessary covers prior to inspection.

1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of transformer's electrical power connections.
2. Instrument: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C.
3. Record of Infrared Inspection: Prepare a certified report that identifies testing technician and equipment used, and lists results as follows:

    a. Description of equipment to be tested.
    b. Discrepancies.
    c. Temperature difference between area of concern and reference area.
    d. Probable cause of temperature difference.
    e. Areas inspected. Identify inaccessible and unobservable areas and equipment.
    f. Identify load conditions at time of inspection.
    g. Provide photographs and thermograms of deficient area.

4. Act on inspection results according to recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 26 12 19

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for enclosed motor starters.
B. The enclosed motor starters specified in this Section are:
   1. Manual Motor Starters
   2. Magnetic Motor Starters
   3. Combination Motor Starters

1.2 REFERENCES

A. The following is a listing of the publications referenced in this Section:

National Electrical Manufacturers Association (NEMA)

UL 489	Molded Case Circuit Breakers
NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA KS1	Enclosed Switches

National Fire Protection Association (NFPA)

NFPA 70	National Electrical Code

Underwriters Laboratories Inc. (UL)

UL 198C	High-Interrupting Capacity Fuses; Current Limiting Type
UL 198E	Class R Fuses

1.3 QUALITY ASSURANCE

A. Enclosed motor starters of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three (3) years.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.
B. Store materials in a clean, dry space and protect them from weather.
C. Handle in a manner to prevent damage to finished surfaces.
D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.
E. Touch up any damage to finishes to match adjacent surfaces.

1.5 SUBMITTALS

A. Submit catalog cuts for the following in accordance with the requirements of Division 1:

   1. Manual Motor Starters

2. Magnetic Motor Starters
3. Combination Motor Starters

B. Catalog cuts shall indicate voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Provide manufacturer installation instruction for storage, handling, protection, examination, preparation, installation, and starting.

1.6 CODES AND STANDARDS

A. Equipment shall conform with the requirements of NFPA 70.

B. Equipment shall be listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric

B. Square D

C. No substitutions

2.2 MATERIALS

A. General
1. Equipment shall be in conformance with the applicable paragraphs below.

B. Manual Motor Starters
1. Manual Motor Starters shall be NEMA ICS2, AC general-purpose Class A manually operated, full-voltage controller with thermal overload unit, and operator.
2. Enclosure shall be NEMA 12, unless otherwise shown on the Contract Drawings.

C. Magnetic Motor Starters
1. Magnetic motor starters shall be NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
2. Coil operating voltage shall be 120 volts, 60 Hz.
3. Coils shall be of encapsulated type.
4. Three (3) pole, unless otherwise shown on the Contract Drawings.
5. Not less than Size 1, or as shown on the Contract Drawings.
6. Contacts shall be totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
7. Wiring shall be straight-through wiring with all terminals clearly marked.
8. Overload Relay shall be NEMA ICS, melting alloy, with one-piece thermal unit construction. Thermal units shall be interchangeable. Overload relay control circuit contact shall be replaceable. Thermal units shall be required for starter to operate.
9. Enclosure shall be ANSI/NEMA ICS 6, Type 1 unless otherwise shown on the Contract Drawings.
10. Provide Auxiliary Contacts, NEMA ICS 2, 2 each normally open and closed contacts in addition to seal-in contact.
11. Pilot Devices shall be NEMA ICS 2, heavy duty type.
12. Pilot Device Contacts shall be NEMA ICS 2, Form Z, rated A150.
13. Push buttons shall be recessed type.

14. Indicating lights shall be provided.
15. Selector Switches shall be Rotary type.
16. Control Power Transformers shall be 120 volt secondary. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

D. Combination Motor Starter - Circuit Breaker Type
1. Provide magnetic motor starter with thermal magnetic circuit breaker disconnect in a common enclosure.
a. Thermal Magnetic Circuit breaker shall be NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole. Circuit breaker shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON-OFF with red and black color coding.
b. Magnetic motor starter shall be per the Magnetic Motor Starter requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed motor starter at the locations shown on the Contract Drawings and as required by NFPA 70.
B. Securely mount all enclosed motor starters and support the enclosed motor starters independently of the conduits entering them.
C. All installation shall conform to NFPA 70.
D. Select and install overload heater elements in motor starter to match installed motor characteristics.
E. Provide engraved nameplates.
F. Provide neatly typed label inside of each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for disconnect switches.
B. The disconnect switches specified in this Section are:
   1. Heavy Duty

1.2 REFERENCES

A. The following is a listing of the publications referenced in this Section:

National Electrical Manufacturers Association (NEMA)

NEMA KS1	Enclosed Switches
NEMA 250	Enclosures for Electrical Equipment

Underwriters Laboratories Inc. (UL)

UL 98	Enclosed and Dead Front Switches

1.3 QUALITY ASSURANCE

A. Disconnect switches of types and sizes required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three (3) years.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened, protective packaging.
B. Store materials in a clean, dry space and protect them from weather.
C. Handle in a manner to prevent damage to finished surfaces.
D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.
E. Touch up any damage to finishes to match adjacent surfaces.

1.5 SUBMITTALS

A. Submit catalog cuts for the following in accordance with the requirements of Division 1:
   1. Heavy Duty Disconnect Switches.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric
B. Square D
C. No substitutions

2.2 MATERIALS

A. General
   1. Disconnect switches identified for use as service entrance equipment shall be labeled for this application.
   2. Enclosures shall be NEMA 12, unless otherwise noted or required to suit the application as required in accordance with the NEC.
   3. For single phase motors, a toggle switch rated 20 amperes will be acceptable for disconnecting motors rated 3/4 horsepower or less.

B. Heavy Duty Disconnect Switches
   1. Switch Interior
      a. All switches shall have switch blades which are visible when the switch if OFF and the cover is open.
      b. Lugs shall be front removable and UL listed for copper 75 deg C conductors.
      c. 30 through 100 ampere switches shall be equipped with factory installed fuse pullers.
      d. All current carrying parts shall be plated to resist corrosion.
      e. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
      f. Switches shall have provisions for a field installable electrical interlock.
   2. Switch Mechanism
      a. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
      b. The operating handle shall be an integral part of the box, not the cover.
      c. Provisions for padlocking the switch in the OFF position shall be provided.
      d. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
      e. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
   3. Switch Enclosures
      a. Switch covers shall be securely fastened.
      b. The enclosure shall have ON and OFF markings stamped into the cover.
      c. The operating handle shall be provided with a dual colored red/black position indication.
      d. NEMA Type 3R enclosures shall be provided with tangential knockouts to facilitate ease of conduit entry for switches rated not greater than 200A.
      e. NEMA Type 12 and 4 enclosures shall contain no knockouts. Supply watertight hubs.
   4. Switch Ratings
      a. Switches shall be horsepower rated.
      b. The UL listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses, 30-600 ampere switches employing appropriate fuse rejection schemes.
   5. Double Throw Safety Switch

a. The double throw safety switch shall meet all the requirements of the Heavy Duty Disconnect Switch.
b. Double throw safety switch shall be designed for manual transfer of load(s) from one supply to another.
c. Shall be U.L. Listed and suitable for use in accordance with Article 702 of the NEC, ANSI/NFPA 70.
d. Shall be U.L. Listed as suitable for service equipment.
e. Double throw safety switch shall be fused or non-fusible as shown on the contract drawings, 3-pole, solid neutral, voltage as indicated on the one-line.
f. Shall NEMA 12/3R gasketed or as indicated on the Contract Drawings.
g. Double throw safety switch shall be continuously rated for its nameplate ampere rating.
h. Double throw safety switch shall be load make/break rated.
i. Shall be a Square D.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches at the locations shown on the Contract Drawings and as required by NFPA 70.
B. Securely mount all disconnect switches in a manner approved by the Engineer and support the disconnect switches independently of conduits entering them.
C. Install disconnect switches in classified (hazardous) locations in accordance with their listing or label requirements.
D. All installation shall conform to NFPA 70.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for wiring devices.

1.2 REFERENCES

A. The devices specified in this section shall be:
   1. Manufactured in compliance with the standards of the National Electrical Manufacturers Association (NEMA)
   2. Underwriters Laboratories (U.L.) listed and labeled.
   3. Installed in conformance with the National Electrical Code (NEC).

1.3 QUALITY ASSURANCE

A. Wiring devices, of types and ratings required, shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

1.4 DELIVER, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, protective packaging.
B. Store materials in a clean, dry space and protect them from weather.
C. Handle in a manner to prevent damage to finished surfaces.
D. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of final cleanup.

1.5 SUBMITTALS

A. Submit catalog cuts for the following in accordance with the requirements of Division 1:
   1. Receptacles
   2. Switches
   3. Device Plates
   4. Dimmer
   5. Occupancy Sensors
   6. Surface Mount Multi-Outlet Raceway System

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements of this Section, provide wiring devices of one of the following manufacturers:
   1. Arrow Hart
   2. Bryant
   3. General Electric Co.
   4. Hubbell
   5. Leviton Mfg. Co., Inc.
   6. Lithonia
   7. Lutron
   8. Pass and Seymour
   9. Sensor Switch
   10. Wiremold
   11. Thomas & Betts

B. Receptacle Part Numbers

	Arrow Hart	Bryant	General Electric	Hubbell	Leviton	Pass & Seymour
Standard	5362I	5362I	GE 5362-2	5362-I	5362-I	5361 I
Corrosion Resistant	5362CR	5362-CR	GE-0526-C	530CM62	5362-CR	CR 6300

C. Switch Part Numbers

	Arrow Hart	Bryant	General Electric	Hubbell	Leviton	Pass & Seymour
Single Pole	1991 I	4901-I	GE-5951-2G	HBL1221 I	1221-2I	20AC1-I
Double Pole	1992 I	4902-I	GE-5952-2G	HBL1222 I	1222-2I	20AC2-I
Three Way	1993 I	4903-I	GE-5953-2G	HBL1223 I	1223-2I	20AC3-I
Four Way	1994 I	4904-I	GE-5954-2G	HBL1224 I	1224-2I	20AC4-I
Pilot Light	1991 PL	4901-PLR	SP-121-8G	HBL1221 PL7	1221-PLR	20AC1-RPL
Key Switch	1991 L	5901-L	GE-5931-OLG-2G	HBL1221L	1221-2IL	20AC1-L

2.2 GENERAL

A. Receptacles
1. Convenience receptacles shall be NEMA 5-20R, 20A, 125V, 2 Pole, 3-wire back and side wired specification grade with:
   a. One-piece grounding system.
   b. High impact chemical resistant nylon face.
   c. Green hex-head grounding screw.
   d. Break-off tab for two circuit wiring.
   e. One piece, line contact to provide low resistance and low heat rise.
2. Special receptacles such as welding, dryer, range or twist lock receptacles shall be specification grade and as described on the Contract Drawings.

B. Switches
1. 20 AMP single pole, double throw specification grade switch with:
   a. Side and back wiring
   b. One piece contact arm
   c. Silver alloy contacts
   d. Thermoplastic or nylon toggle
   e. Grounding terminal

2. 20A double pole, 3-way and 4-way switches shall comply with 2.02 B.1 a through e. Devices shall be installed where shown on the Contract Drawings.

C. Device Plates
1. Type 302, .032 inch thick stainless steel with brushed face and beveled edges.
2. Wall plates shall be one piece. Sectional plates are not acceptable.

D. Multi-Outlet Assemblies
1. Multi-outlet assemble shall be a surface mount unit and consist of:
   a. Base
   b. Pre-punched cover
   c. Wired receptacle harness
   d. Appropriate fittings
   e. Grounding clamp
2. The length of the strip shall be 60". The center distance between outlets shall be 12". The strip housing shall steel with an ivory finish.
3. The unit shall include five (5) receptacles. The receptacles shall be NEMA 5-20R, 20A, 125V, 2 Pole, 3-wire back and side wired specification grade..
4. Multi-Outlet system shall be Wiremold, Model 24S6012GBX99IV or equal.
5. Devices shall be installed where shown on the Contract Drawings.

E. Color Selection
1. Wiring devices shall be available in standard white, ivory, grey, brown and black.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Switches
1. Shall be installed in boxes.
2. Shall be pulled up tight so switch is secure and rigidly mounted.
3. Shall be installed with a cover plate.
4. If side wired, wire shall be looped in a clockwise direction and shall be fully under head of terminal. Side wired terminals shall only be used with solid conductor wire.
5. If back wired, conductor shall be fully seated, and exposed conductor shall not be visible.
6. Shall have wire terminals tightened to a minimum of 14 inch pounds.
7. Shall have plates fit tight to surface without gaps or strain on plate.
8. Shall be installed (48) inches above finished floor, unless otherwise noted on the Contract Drawings.
9. Where more than one switch is shown on the drawings in one location, they shall be installed in a switch box of proper size for the number of devices. The cover plate shall be one piece.
10. Voltage barriers shall be used in switch boxes where more than one voltage is present.
11. Shall be installed plumb and parallel to adjacent surfaces.
12. Shall be installed so that single and double pole switches are in the up position when load is on.
13. Shall be protected by 15 or 20 ampere overcurrent protective devices.

B. Miscellaneous Switches
1. Required as shown on the Contract Drawings.

C. Receptacles shall be:
1. Rated 20A,125 Volt.
2. Installed in outlet boxes and have cover plates installed so they fit tight to surface without

gaps or strain on plates.

3. Installed 18 inches above finished floor unless otherwise noted on the electrical drawings.
4. Mounted so that the center of the box is eight inches above the finished counter when noted Above Finished Counter (AFC) on on the Contract Drawings.
5. Mounted so as to be readily accessible (eg: cord connected disposals shall have receptacle mounted in base cabinet so it is not obstructed by piping).
6. Installed with ground slot at bottom of device.
7. Furnished with matching plugs for all non-standard receptacles, and 1 plug for every 4 devices of same type and rating.

D. Dust and Moisture Resistance Receptacles
1. Used in floor outlets, in shops, or other locations as noted on the Contract Drawings.

E. Corrosion Resistant Receptacles
1. Used for all exterior receptacles, receptacles in boiler rooms, water treatment rooms, and other areas as noted on the Contract Drawings.

F. Power receptacles rated 30A and greater shall be:
1. Installed where noted and be of the NEMA configuration shown on the Contract Drawings complete with correct cover plate of same color and style as specified for other devices unless otherwise noted on the Contract Drawings. Furnish matching plug with each device.

G. Security Devices and Plates
1. Installed where noted on the Contract Drawings.
2. Where padlocks are called for, they shall be installed on the device and shall be keyed alike.

H. Door Switches shall be:
1. Installed where noted on the Contract Drawings.
2. Mounted in the jam on the same side as the hinges are mounted.

I. Pilot Lights shall be:
1. Installed where noted on the Contract Drawings.
2. Installed in an outlet box and be complete with the appropriate cover plate of same color and style as specified for other devices.
3. When shown on the Contract Drawings in the same relative location as light switches, ganged along with the switches and under the same cover plate.
4. Labeled on the plate as to use. Label shall be by engraving the cover plate with 1/16 inch high letters of a contrasting color (white for dark plates, black for light plates).

J. Cover Plates shall:
1. Fit tight and flat to surface without placing a strain on the plate.
2. Be of the correct type for the location, box type and device type.
3. Be weatherproof, where noted on the Contract Drawings, for exterior and wet locations.
4. Include blank plates installed on all boxes which do not have devices installed in them.
   a. Phone outlets which are not being used for phones at the present time shall be covered by blank plates.
   b. Phone plates (with a hole for wire in center of plate) are not generally required. Electrical Contractor shall coordinate the locations of tap boxes for the phones with the telephone system contractor. Boxes which are not used shall have blank plates installed. If phone tap boxes are not installed over phone outlet boxes, Contractor shall furnish appropriate plates to cover outlet boxes.

K. Multi-outlet assemblies shall:
1. All multi-outlet assemblies shall mechanically continuous and connected all electrical outlets, boxes and cabinets in accordance with manufacturer's installation sheets.
2. Raceway shall be securely supported in accordance with the manufacturer's installation

sheets.

3. Work shall include furnishing the mounted multi-outlet assemble unit, appropriate fittings, device boxes and plates to install a complete surface mounted multi-outlet assemble system as indicated on the electrical drawings and in this specification. The assemble openings shall be closed.

L. Colors

1. Devices shall be ivory, unless otherwise shown on the Contract Drawings or the Architect/Engineer will select device colors to coordinate with room finishes. If color schedule is not received prior to date required (see submittals) ivory devices shall be used, except where other colors are required by this specification or shown as not being available. Device color may be revised to another standard manufacturer color (brown or gray) during the submittal process.

M. Light switches and 20A, 120 V receptacles shall all be of the same manufacturer unless otherwise approved.

N. Low voltage component system shall be installed as shown on the Contract Drawings.

3.2 FIELD TESTS

A. Prior to energizing circuitry, test wiring for electrical continuity and short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements of these Specifications.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements for overcurrent protective devices.
B. The types of overcurrent protective devices specified in this Section are:
   1. Molded Case Circuit Breakers
   2. Fuses

1.2 REFERENCES

The following is a listing of the publications referenced in this Section:
1. American National Standards Institute (ANSI)
   a. ANSI C 97.1: Low Voltage Cartridge Fuses 600 Volts or Less
2. National Electrical Contractors Association (NECA)
   a. NECA 5005: Standard of Installation
3. National Fire Protection Association (NFPA)
   a. NFPA 70: National Electrical Code
4. Underwriters Laboratories Inc. (UL)
   a. UL 198: Safety Standard for Class H Fuses

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

The overcurrent protective devices and associated materials shall conform to all applicable standards, to the requirements specified herein, and as shown on the Contract Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Overcurrent protective devices as part of an assembly, as shown on the Contract Drawings, shall be mounted and delivered in accordance with the manufacturer's recommendations.
B. Overcurrent protective devices to be installed, as shown on the Contract Drawings, shall:
   1. Be packaged to prevent damage to components due to vibration and jarring during transportation and handling.
   2. Enclosures for overcurrent protective devices shall be delivered in the manufacturer's original, unopened, protective packaging and shall be identified with suitable non-corrosive tags.
C. Where possible, maintain protective coverings until installation is complete and remove such coverings as part of the final cleanup.

1.5 SUBMITTALS

Submit the following in accordance with the requirements of Division 1:

A. Shop Drawings
   1. Fuses; time-current and current-limiting curves for both melting and clearing.
   2. Circuit breakers; time-current curves.
B. Catalog Cuts
   1. Molded case circuit breakers

2. Fuses
3. Enclosures

1.6 SPARE PARTS

Furnish 10% spare fuses (not less than 6) of each type and rating shown on the Contract Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the requirements of this Section, provide molded case circuit breakers of one of the following manufacturers:
   1. General Electric Company
   2. Square D. Company
   3. Matching existing manufacturer where being expanded.
   4. No Substitutions
B. Subject to compliance with the requirements of this Section, provide fuses of one of the following manufacturers:
   1. Cooper Industries Incorporated/Bussman Division
   2. Littlefuse Incorporated

2.2 MATERIALS

A. General
   1. Location, types, sizes, ratings and enclosures for overcurrent protective devices are shown on the Contract Drawings.
   2. Enclosures for overcurrent protective devices, mounted in their own enclosures as shown on the Contract Drawings, shall conform to the requirements of NEMA, UL, and NFPA. Enclosures shall be as specified in the Section of these Specifications entitled “PANELBOARDS".
   3. Overcurrent protective devices, to be installed as part of an assembly unit as shown on the Contract Drawings, shall be installed in accordance with the manufacturer's requirements for the specified assembly or as shown on the Contract Drawings.
   4. Overcurrent protective devices and enclosures for which there are established UL standards shall bear the UL label.
B. Molded Case Circuit Breakers
   1. Molded case circuit breakers shall be molded-case type, quick-make and quick-break on manual or automatic operation.
   2. The handle mechanism shall be trip-free to prevent holding contacts closed on a fault.
   3. Tripping shall be indicated by the handle automatically assuming a position between the manual "off" and "on" positions.
   4. Automatic operation of the molded case circuit breaker shall be obtained by means of calibrated thermal and magnetic tripping devices for each pole of the breaker. The thermal device shall provide time-delay tripping on overloads. The magnetic device shall provide instantaneous tripping on short circuits. The instantaneous magnetic trip shall be adjustable and accessible from the front of the breaker on frame sizes above 100 amperes.

5. Molded case circuit breaker contacts shall be of the high pressure type and shall be made of a silver composition material. Arc shields shall be provided to confine, cool, and quench the arc drawn at interruption.
6. Continuous ampere ratings and number of poles shall be as shown on the Contract Drawings.
7. Molded case circuit breakers shall be bolt-on type.
8. Unless otherwise shown on the Contract Drawings:
   a. 120V or 208V circuit breakers shall have a short circuit interrupting rating of not less than 10,000 amperes (RMS symmetrical).
   b. 277V or 480V breakers shall have a short circuit interrupting rating of not less than 22,000 amperes (RMS symmetrical).
9. All molded case circuit breakers feeding 120V or 277V lighting circuits that are not controlled by local wall switches shall be UL approved type "SWD" circuit breakers.
10. Each molded case circuit breaker shall be suitable for the circuit on which it is applied and the load which it controls.
11. The following accessories shall be provided as shown on the Contract Drawings:
    a. auxiliary switches
    b. shunt trips
    c. undervoltage trips
    d. ground fault sensing and tripping

C. Fuses

1. Fuses shall be of the class, size and ratings (current, voltage, interrupting capacity, type, NEMA class) as shown on the Contract Drawings.
2. Fuses shall conform to UL 198 and ANSI C97.1 for low voltage fuses.
3. Unless otherwise shown on the Contract Drawings, fuses shall be current limiting, dual element, RK-1 type.
4. Fuses 601-6000 amps shall be:
   a. Bussmann Low-Peak KRP-C
   b. Littelfuse KLP-C
5. Fuses 1/10-600 amps shall be:
   a. Bussmann Low-Peak LPS-RK
   b. Littelfuse LLS-RK
6. Fuses 1-600 amps in Class J Style only shall be:
   a. Bussmann LPJ
   b. Littlefuse JTD

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

Unless otherwise shown on the Contract Drawings, overcurrent protective devices shall be installed in conformance with NFPA 70 and NECA 5055, in accordance with the manufacturer's instructions and the requirements of this Section.

B. Fuses

1. All fuses rendered inoperative during the Work shall be replaced before completion.
2. All replacement fuses shall be provided in addition to the spare fuses specified herein.

END OF SECTION

SECTION 26 29 33 – ADJUSTABLE SPEED DRIVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification describes a complete Adjustable Speed AC Drive (ASD) used to control the speed and torque of NEMA design B induction motors.

B. The ASD manufacturer shall supply the ASD and all necessary controls as herein specified.

C. The ASD shall be manufactured by a company with at least twenty (20) years of experience in the production of this type of equipment.

1.2 QUALITY ASSURANCE

A. The ASD manufacturing facility shall be ISO 9001 and ISO 14001 certified.

B. All printed circuit boards shall be completely tested before being assembled into the complete ASD. The ASD shall be subjected to a functional test and load test. The load test shall be at full rated load, or cycled load.

C. The ASD manufacturer shall have an analysis laboratory to evaluate the failure of any component.

1.3 QUALIFICATIONS

A. The ASD shall meet the following specifications:

1. UL 508A and/or 508C - Underwriter's Laboratory. The ASD shall be UL listed and carry the UL mark.
2. CAN/CSA-C22 No. 14-M91 - Canadian Standards Association. The ASD shall be C-UL or CSA listed and carry the appropriate mark.
3. The ASD shall comply with the following European Union’s CE directives and shall carry the CE mark:

    a. EMC Low Voltage Directive 73/23 EEC
    b. EMC Directive 89/336 EEC
    c. Machinery Directive 98/37 EC

B. Acceptable manufacturers:

1. ABB Inc. ACS880 series of AC ASDs
2. ASD manufacturer shall: design, manufacture, quality control and life cycle manage all products offered on this project.
3. ASD vendors that brand label products manufactured by others shall not be allowed.

1.4 SUBMITTALS

A. The Submittals shall include the following information:

1. Outline dimensions and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description including a complete list of options provided.
4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD). The ASD manufacturer shall provide calculations; specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the ASD manufacturer to ensure compliance with the IEEE electrical system standard 519. All ASDs shall include a minimum of 3% equivalent impedance reactors, no exceptions

1.5 DESCRIPTION

A. The ASD shall be a solid state AC to AC inverter controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology. The ASD shall utilize Direct Torque Control (DTC) as the primary motor control, employing an inner loop torque control strategy that mathematically determines the optimal motor torque and flux every 25 microseconds. The ASD shall also provide an optional motor control operational mode for scalar of V/Hz operation.

B. The benefits that the motor control DTC shall make available for the operation of a NEMA design B induction motor shall be:

1. Steady state speed accuracy within 1/10th the slip without an encoder, for process repeatability.
2. 100% motor torque from zero speed available for acceleration with the ASD continuous current rating equal to or greater than the motor full load amp rating.
3. At and below 90% speed, 100% torque is achievable even with 10% low line voltage.
4. Ability to limit torque to protect the mechanical system with a common single torque setting above and below field weakening.
5. Ability to provide torque in % of motor shaft torque (within +/- 4% linearity) on the ASD control panel, analog output or via field bus of actual.
6. Quiet motor operation for audibly friendly working environment in comparison to other low voltage PWM solutions utilizing a carrier frequency.
7. Have available the ability to operate in open loop torque control, with an ability to switch between speed and torque control on the fly with the change of state to a digital input.
8. Have an ability to share load or speed between two or more induction AC motors connected to the same system, when those motors are controlled by separate ASDs.

PART 2 - PRODUCTS

2.1 RATINGS

A. The ASD shall be rated to operate from 3-phase power at 380 to 690 VAC +10/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

B. The ASD shall be rated to operate at the following environmental operating conditions:

1. Ambient temperature 0 to 40°C continuous and up to 50°C continuous with a derating factor.
2. Altitude 0 to 3300 feet above sea level without derating, less than 95% humidity, non-condensing.

C. The ASD shall be offered from 60 to 4250 HP in similar construction and operation, using the same technology.

D. The ASD shall be rated to operate from input power from 48Hz to 63Hz.

E. Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.

F. The Light Duty overload current capacity shall be 110% of rated current for one (1) minute out of five (5) minutes.

G. The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.

H. The ASD efficiency shall be 98% or better of the full rated capability of the ASD at full speed and load.

2.2 CONSTRUCTION

A. All models shall provide a complete, ready-to-install solution.

B. The latest, most efficient IGBT power technology shall be used. This technology shall be used for all power and voltage ranges offered by the manufacturer.

C. The ASD shall offer microprocessor based control logic that is isolated from power circuitry.

D. Control connections shall remain consistent for all power ratings.

E. Cabinet ASDs shall be available from 60 to 4250 HP and have the following features:

1. Offered in UL Type 1 and UL Type 12 with filter and forced air enclosures.
2. Include a control panel mounted on the front of the ASD enclosure door.
3. Single point power connections per each electrical phase.
4. Include integrated internal AC line reactor or DC choke.
5. Include input disconnect or Molded Case Circuit Breaker (MCCB) with through the door interlock lockable in the off position.
6. Include high speed input AC line fuses for protection of the input bridge.
7. Offer option internally mounted braking chopper for use in dynamic braking.
8. Common mode filter standard above 200 HP, optional below 200 HP.

F. Desired optional features shall be furnished and mounted by the ASD manufacturer and shall also be available as field installable kits as an alternative. All optional features shall carry all of the necessary certifications as described in Section 1.03. Field installed kits shall not affect the ASD’s certification.

2.3 OPERATOR INTERFACE

A. The ASD shall be equipped with a front mounted operator control panel consisting of:

1. A four- (4) line back-lit alphanumeric LCD display that is 240x160 pixels.
2. Configurable displays showing, bar graph and meter.
3. Keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.

B. The control panel shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple ASDs.

C. The display of the control panel shall have the following features:

1. All parameter names, fault messages, warnings and other information shall be displayed in complete American English words or standard American English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
2. Additional languages including French, Spanish, Portuguese, German, Italian, Dutch, Danish, Swedish, Finnish, Russian, Turkish and Chinese shall be selectable.
3. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:

    a. Speed/torque in percent (%), RPM or user-scaled units.
    b. Output frequency, voltage, current and torque.
    c. Power and kilowatt hours.
    d. Heatsink temperature and DC bus voltage.
    e. Status of discrete inputs and outputs.
    f. Values of analog input and output signals.
    g. Values of PID controller reference, feedback and error signals.

D. The control panel shall be used for local control, for setting all parameters, and for stepping through the displays and menus.

E. The control panel shall include a front accessible USB connection port to connect a PC to the ASD for configuration, monitoring and troubleshooting from outside the enclosure.

F. The control panel shall be Bluetooth™ capable and there shall be an available application for a portable hand held device (ie cell phone, tablet) to control, monitor or troubleshoot the ASD.

G. An intelligent start-up assistant shall be provided as standard. The start-up routine will guide the user through all necessary adjustments to optimize operation.

1. The start-up routine shall include “plug and produce” operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.
2. The start-up routine shall prompt the user for motor nameplate data including power, speed, voltage, frequency and current.
3. An auto-tune function shall identify the optimal motor tuning parameters for typical applications.
4. An auto-tune function shall also be available to tune the PID speed regulator loop; manual adjustments shall also be allowed.
5. A selection of at least six (6) preprogrammed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of four (4) user defined parameter sets shall are also be available.
6. Selection shall be offered for both 2-wire and 3-wire Start/Stop control.

2.4 PROTECTIVE FEATURES

A. For each programmed warning and fault protection function, the ASD shall display a message in complete English words or Standard English abbreviations. The ASD shall be capable of displaying up to five (5) active faults and store the previous five (5) non-active faults and provide a real time stamp when they occurred. The ASD shall provide a help feature to further explain the displayed fault.

B. The ASD shall include internal MOV’s for phase to phase and phase to ground line voltage transient protection.

C. Output short circuit and ground fault protection rated for 100,000 amps shall be provided per UL508A.

D. Motor phase loss protection shall be provided.

E. The ASD shall provide electronic motor overload protection qualified per UL508C.

F. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage.

G. The ASD shall protect itself against input phase loss.

H. Power loss ride through feature shall allow the ASD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

I. Stall protection shall be programmable to provide a warning or stop the ASD after the motor has operated above a programmed torque level for a programmed time limit.

J. Underload protection shall be programmable to provide a warning or stop the ASD after the motor has operated below a selected underload curve for a programmed time limit.

K. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

L. Input terminals shall be provided for connecting a motor thermistor (PTC type) to the ASD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

2.5 CONTROL INPUTS AND OUTPUTS

A. Discrete Inputs

1. Minimum of six (6) discrete inputs shall be provided.
2. Minimum of six (6) shall be independently programmable with function selections (run/stop, hand-off-auto, etc.).
3. Inputs shall be designed for use with either the ASD's internal 24 VDC supply or a customer supplied external 24 VDC supply.

B. Discrete outputs

1. Minimum of two (2) form C relay contact outputs shall be provided
2. All outputs shall be independently programmable to activate with at least 30 function selections including;

    a. Operating conditions such as drive ready, drive running, reversed and at set speed
    b. General warning and fault conditions.
    c. Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque, and PID feedback.
    d. Relay contacts shall be rated to switch 2 Amps at 24 VDC or 115/230 VAC.

C. Analog Inputs

1. Minimum of two (2) analog inputs shall be provided:

    a. Two (2) shall be selectable for either a current or a voltage input.
    b. Resolution of analog inputs shall be at least 11bit total resolution.

2. Inputs shall be independently programmable to provide signals including speed / frequency reference, torque reference or set point, PID set point and PID feedback / actual.
3. A differential input isolation amplifier shall be provided for each input.
4. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.
5. If the input reference is lost, the ASD shall give the user the option of the following (the ASD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus):

    a. Stopping and displaying a fault.
    b. Running at a programmable preset speed.
    c. Hold the ASD speed based on the last good reference received.
    d. Cause a warning to be issued, as selected by the user.

6. When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a “joystick” reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

D. Analog Outputs

1. Minimum of two (2) 0 / 4-20 mA analog outputs shall be provided.
2. Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

E. Digital Inputs/Outputs

1. Minimum of two (2) digital inputs/outputs shall be provided.
2. Minimum of one (1) can be programmed as a frequency input.
3. Minimum of one (1) can be programmed as a frequency output.

F. Safety Inputs

1. A Safe Torque Off (STO) terminal shall be integrated in the drive as a standard.
2. The STO function shall meet a Safety Integrity Level (SIL) 3 and a Performance Level (PL) e.
3. The STO function shall be certified by a third party approval agency e.g. TUV Nord.

G. SERIAL COMMUNICATIONS

1. The ASD shall be capable of communicating with other ASDs or controllers via a serial communications link. A variety of communications interface modules for the typical overriding control systems shall be available.

H. Interface modules shall be available for a wide selection of protocols including but not limited to:

1. Modbus
2. Ethernet IP
3. ModBus TCP
4. ControlNet
5. DeviceNet
6. Profibus
7. ProfiNet
8. CANOpen
9. EtherCat
10. EtherPOWERLINK

I. Interface modules shall mount directly to the ASD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.

J. I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:

1. Run-Stop control
2. Hand-Off-Auto Control
3. Speed Adjustment
4. PID (proportional/integral/derivative) control adjustments
5. Current Limit
6. Accel/Decel time adjustments

K. The ASD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.

L. A connection shall also be provided for personal computer interface. Software shall be available for ASD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of ASD performance.

2.6 CONTROL FUNCTIONS AND ADJUSTMENTS

A. Output frequency shall be adjustable from 0 to 500 Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

B. Stop mode selections shall include coast to stop and ramp to stop.

C. The ASD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.

D. The ASD shall be capable of controlling a rotating motor regardless of the motor direction. From the time the start signal is given to the ASD to the time the ASD has control of the motor shall not exceed two (2) seconds. Once the ASD has control of the motor it will than accelerate or decelerate the motor to the active reference speed without tripping or faulting or causing component damage to the ASD. The ASD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

E. The ASD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

F. Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.

G. Speed control functions shall include:

1. Adjustable min/max speed limits.
2. Selection of up to 15 preset speed settings for external speed control.
3. Three sets of critical speed lockout adjustments.
4. A built-in PID controller to control a process variable such as pressure, flow or fluid level.

H. Functions shall include flux optimization for optimizing energy efficiency and limit the audible noise produced by the motor by providing the optimum magnetic flux for any given speed / load operating point.

I. The ASD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The ASD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for ASD acceleration from zero speed without signaling a false underload condition.

J. Three (3) programmable critical frequency lockout ranges shall be provided to prevent the ASD from operating the load continuously at an unstable speed.

K. The ASD shall offer software to select the ASD's action in the event of a loss of the primary speed reference.

2.7 Cabinet ASDs from 60 to 4250 HP

A. UL Type 12 (IP55) enclosure.

B. Bottom Entry and/or Exit of power and control cables.

C. Prevention of unexpected start through the use of redundant and non-processor based control complying with SIL3 (Safety Integrity Levels) as per IEC 61508.

D. Input AC line contactor and E-Stop category 0 or category 1.

E. Dynamic braking chopper internally mounted in ASD enclosure available through 1350 HP at 480 VAC (1200 HP at 690 VAC).

F. Second Environment EMC / RFI filter

G. A dv/dt output filter internally mounted in ASD enclosure available through 700 HP at 480 VAC.

H. Common output filters internally mounted in ASD enclosure available through 4250 HP at 690 VAC.

I. An option shall be provided for ground fault protection in un-grounded (floating) networks.

J. Input and Output extension modules:

1. Analog input and output expansion.
2. Digital input and output expansion.
3. Speed and position feedback for TTL incremental encoder.
4. Speed and position feedback for resolver interface.
5. Fieldbus communication modules (protocols):

    a. DeviceNet
    b. ControlNet
    c. EtherNet / IP
    d. ModBus TCP
    e. ModBus
    f. ProfiBus DP
    g. ProfiNet
    h. CANopen
    i. EtherCat
    j. EtherPOWERLINK

PART 3 - EXECUTION

3.1 INSTALLATION

A. The ASD manufacturer shall provide adequate drawings and instruction material to facilitate installation of the ASD by qualified electrical and mechanical personnel employed by others.

3.2 START-UP

A. Certified factory start-up shall be provided for each ASD by a factory authorized service center. A certified start-up form shall be filled out for each ASD with a copy provided to the owner, and a copy kept on file at the manufacturer.

B. The factory will extend the normal warranty for the ASD with a certified factory start-up.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the ASD products offered shall be locally available at both the specifying and installation locations.

B. A 24/365 technical support line shall be available on a toll-free-line.

3.4 WARRANTY

A. Standard Warranty shall be 12 months from the date of start-up, not to exceed 18 months from the date of shipment. The warranty shall include all parts.

B. With a certified start-up (applicable in the USA and Canada only), warranty shall be 24 months from the date of start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time, and expenses.

C. There shall be 24/365 support available on a toll-free-line.

END OF SECTION 26 29 33

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes products and requirements for "Uninterruptible Power Supply Unit" UPS.
B. Related Requirements:
   1. Electrical Division 26-nn-nn.
   2. Process Instrumentation and Control 40-90-nn

1.02 REFERENCES

A. Reference Standards:
   1. NEMA PE 1 – Uninterruptible Power Systems.
   2. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
   3. NFPA 70 – National Electrical Code.

1.04 ACTION SUBMITTALS 01-33-00

A. Product Data: Provide electrical characteristics and connection requirements; detailed equipment outlines, weight, and dimensions; location of conduit entry and exit; single-line diagram indicating metering, control, and external wiring requirements; heat rejection and air flow requirements. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.

1.05 CLOSEOUT SUBMITTALS

A. Test Reports: Reports submitted as discussed in the Commissioning of Systems 26-08-nn.
B. O & M:
   1. Submit Operation Data and description of servicing procedures; list of major components; recommended remedial and preventive maintenance procedures; spare parts list.
C. Guaranty: The guaranty period for all items covered by this Section shall be for five (5) years from date of Owner equipment acceptance, as specified in the General Conditions.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Uninterruptible Power Supply:
   1. An uninterruptible power system (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power. The UPS shall include audio and visual alarms in order to keep operators continuously advised on system status.
      a. The UPS shall be comprised of static inverter, a precision hysteresis loop battery charger, sealed maintenance free batteries, a relay, an RS-232 computer interface port, and shall be contained in a single compact package.
      b. Under normal operating conditions, the critical load shall be powered by normal AC line supply that has been filtered through a surge suppression network. When AC line power is present, the static inverter shall be normally off.
      c. When AC line power fails, the inverter shall supply AC power to the transformer from the battery source. There shall be no break in the output of the system during transfer from normal AC line supply to inverter battery supply or back to line. A single switch shall turn the system on and off. There shall also be an audible alarm disconnect switch.

d. The output capacity of the UPS shall be suitable to operate the equipment and devices connected as shown on the Drawings. It shall have a 50% surge capacity for 10 minutes on AC line and a 10% surge capacity for 10 minutes on inverter.

2. System shall have front panel LEDs for AC line, system ready, charger on, inverter on and alarm condition, with additional coded audible signal for low and high battery, near low battery, inverter on, overload, heat sink over temperature, ambient over temperature, high AC and low AC, charger on too long, charger off too long, and DC disconnect.
3. Input: circuit breaker (on/off switch) provides inverter input protection. Fuse for battery charger circuitry.
4. The UPS shall be similar and equal to the Model uninterruptible power systems noted/shown on the Electrical drawings.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with the manufacturers instructions and at location shown on the drawings.

3.02 SYSTEM START-UP

A. Demonstration: Demonstrate operation of the product by simulating an operational occurrence.
B. Training: Provide two (2) hours instruction, each for two persons, to be conducted at the project site with a manufacturer's representative.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section lists requirements for Automatic Transfer Switch, rated 600V or less, as part of the electric power generating.
B. Related Requirements:
   1. Engine Generator Site: 26-32-13.

1.02 REFERENCES

A. Abbreviations:
   1. IEC:
   2. NEPA: National Fire Protection Association
   3. NEMA: National Electrical Manufacturers Association.
   4. UL: Underwriters Laboratory
B. Reference Standards:

UL 1008-	Standard for Automatic Transfer Switches
NFPA 70-	National Electrical Code
NFPA 110-	Emergency and Standby Power Systems
IEEE-	Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
NEMA-	StandardICS10-1993 (formerly ICS2-447) – AC Automatic Transfer Switches
NEC-	Articles 700, 701, 702

1.03 ACTION SUBMITTALS 01-33-00

A. Shop Drawings:
B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer installed and field-installed wiring. Show both power and control wiring.
C. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for load ratings and short-circuit closing and withstand ratings applicable to units for Project.

1.04 INFORMATION SUBMITTAL

A. Test Reports:
   1. Factory Test.
B. Manufacturers Instruction

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. The ATS manufacturer shall be certified to ISO 9001: 2000 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2000.
   2. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
B. Testing:
   1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and

time delay settings are in compliance with the specification requirements.

2. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer:
- ASCO Power Technology: 300 Group G.
- Engine Generator or equal.

2.02 EQUIPMENT

A. Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the drawings. Each automatic transfer shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

1. The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings shall be as follows when used with specific circuit breakers.

ATS Size	**Withstand & Closing Rating MCCB**	**W/CLF**
30	22,000A	100,000
70 – 200	22,000A	200,000
230	22,000A	100,000
260 – 400	42,000A	200,000
600 – 1200	65,000A	200,000
1600 – 2000	85,000A	200,000
2600 – 3000	100,000A	200,000

B. Devices:

1. Mechanically Held Transfer Switch:
   a. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
   b. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
   c. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.
   d. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
   e. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which

are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

f. Where neutral conductors must be switched, the ATS shall be provided with fully-rated neutral transfer contacts.

g. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2. Microprocessor Controller with Membrane Interface Panel:

a. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.

b. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.

c. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. IEEE C37.90.1Voltage Surge Test
2. NEMA ICS – 109.21 Impulse Withstand Test
3. IEC 61000IEC801-2 Electrostatic discharge (ESD) immunity
4. EN 61000– 3 Radiated electromagnetic field immunity
5. IEC 61000– 4 Electrical fast transient (EFT) immunity
6. ENV50142 Surge transient immunity
7. ENV50141: Conducted radio-frequency field immunity
8. EN55011: Group 1, Class A conducted and radiated emissions
9. EN61000 – 4 – 11 Voltage dips and interruptions immunity

2.03 OPERATION

A. Voltage and Frequency Sensing:

1. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.1
2. Single-phase voltage and frequency sensing of the emergency source shall be provided.

B. Time Delays:

1. An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
2. An adjustable time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
3. A generator stabilization time delay shall be provided after transfer to emergency.
4. An adjustable time delay shall be provided on retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
5. A 5-minute cooldown time delay shall be provided on shutdown of engine generator.
6. All adjustable time delays shall be field adjustable without the use of special tools.

C. Additional Features:

1. A set of contacts rated 5 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
2. A push-button type test switch shall be provided to simulate a normal source failure.
3. A push-button type switch to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay whichever delay is active at the time the push-button is activated.
4. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency

and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.

5. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact, closed, when the ATS is connected to the emergency source.
6. Terminals shall be provided to indicate actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.
7. Engine Exerciser – An engine generator exercising timer shall be provided, including a selector switch to select exercise with or without load transfer.
8. Inphase Monitor – An inphase monitor shall be inherently built into the controls. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer.
9. Selective Load Disconnect – A double throw contact shall be provided to operate after a time delay, adjustable to 20 seconds prior to transfer and reset 0 to 20 seconds after transfer. This contact can be used to selectively disconnect specific load(s) when the transfer switch is transferred. Output contacts shall be rated 6 amps at 28 VDC or 120 VAC.

D. Optional Accessories:

1. Communications Interface – Module to allow local or remote communication products. The module shall be used to connect to the serial network via an RS-485 interface.
2. Communications Interface – Module to allow several different serial devices that communicate at different baud rates and with different protocols to a common Ethernet media. The module shall be used to connect the standard Ethernet TCP/IP network with standard 10 base-T (RJ-45) connector.
3. Programmable Engine Exerciser – A seven or fourteen day programmable engine exerciser with digital readout display. Shall include one form C contact for availability of normal and emergency sources. Include “with or without” load control switch for exerciser period. The exerciser shall be backed up by a permanent battery.
4. Enclosure Heater – A 125 watt enclosure heater with transformer and thermostat (adjustable from 30° to 140°F) if Type 3R enclosure is specified.

2.04 FABRICATION ASSEMBLY

A. Enclosure:

1. The ATS shall be furnished in a NEMA Type 1 enclosure unless otherwise shown on the plans.
2. Provide strip heater with thermostat for Type 3R enclosure requirements.
3. Controller shall be flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches.

B. Finishes: The finish shall be ANSI-61, light gray, electrostatically-charged polyester powder paint over a phosphate coating, at a minimum of 2.0 mils in density.

1. Finish shall be suitable for indoor and outdoor environments.
2. Control wiring shall be rated for 600 volt, UL 1015. Wires shall be placed in wire duct or harnessed, and shall be supported to prevent sagging or breakage from weight or vibration. All wiring to hinged doors shall be run through door terminal blocks or connection plugs.

3.01 INSTALLATION

A. Installation:

1. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details.
2. Floor-Mounting Switch: Anchor to floor by bolting.
   a. Floor-mounted transfer switches shall be mounted on concrete. [equipment pads]
3. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

B. Connections:

1. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes if necessary to accommodate required wiring.

2. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
3. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
4. Ground equipment and connect wiring according to Division 26.

3.02 SYSTEM STARTUP

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:
   1. Coordinate this training with that for generator equipment.
   2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
   3. Review data in maintenance manuals.

3.03 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes products and requirements for Transient Voltage Surge Suppressors".
B. Related Requirements:
   1. Electrical Division 26-nn-nn.
   2. Process Instrumentation 40-90-00.

1.2 ADMINISTRATIVE REQUIREMENT

A. Coordination:
   1. Coordinate with other Electrical and Instrumentation Work as necessary to interface the installation of devices/products.

1.4 ACTION SUBMITTALS

A. Product Data: The suppression unit(s), catalog cuts and/or mechanical drawings shall be submitted for approval.
B. Instructions for installation, operation, maintenance, testing, and connection shall be provided with the suppression unit(s).

1.5 CLOSEOUT SUBMITTALS

A. Test Reports: Reports submitted as discussed in the Commissioning of Systems 26-08-nn.
B. Guaranty: The guaranty period for all items covered by this Section shall be for five (5) years from date of Owner equipment acceptance, as specified in the General Conditions.

1.6 QUALITY ASSURANCE

A. Testing:
   1. Each complete suppression unit shall be UL listed, tested, and rated as a transient voltage surge suppressor per UL 1449.
   2. Units shall bear suppressed voltage rating issued by UL and units shall be tested in accordance with ANSI/IEEE C62.41.1 and C62.45, 1.2x50usec, 20 kV open circuit voltage; 8x20usec, 10kA short circuit current, Category C3 Bi-wave minimum, 2500 sequential impulses without failing or degrading the surge suppression rating by more than 5%. Test results shall be submitted.
   3. Only firms that have been regularly engaged in the manufacture of transient voltage surge suppressors of the types and ratings required and whose products have been in satisfactory use in similar service are acceptable.
B. Supplier/Manufacturer:
   1. Square D, Model SDSA1175.
   2. Cutler-Hammer Clipper Power System Model CPS-B.
   3. Square D, Model TVS3HWA50X.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Suppression Unit:
1. The circuit configuration of the suppression units shall be thermal stress reducing, parallel, solid state. Protection Modes: All modes shall be protected, e.e.; Norman(L-L, L-N) and Common(N-G, L-G).
2. The suppression units shall be housed in minimum NEMA Type 1 enclosures.
3. The suppressor shall provide the same level of protection repeatedly when tested in accordance with ANSI/IEEE C62.45-2002, Guide on Surge Testing for Equipment Connected to Low Voltage AC Power.

B. Performance:
1. Application: I phase, 120/240 V, 3 wire + ground, 3 phase 120/240 V 4 wire + ground High-Leg Delta
2. Maximum Continuous Operating Voltage: 275/150V. RMS (L-L/L-N, L-G, N-G).
3. Protection – All Modes: Normal Mode (L-N, L-L) Common Mode (N-G, L-G).

PART 3 – EXECUTION

3.1 PREPARATION

A. Examination:
1. The Contractor shall examine the areas and condition under which the transient voltage surge suppressors are to be installed and advise the supplier in writing of conditions detrimental to the completion of work.
2. Verify the proper application of the TVSS (i.e.; voltage, phases, etc). Coordinate with upstream and downstream transient suppression.

3.2 INSTALLATION

A. Installation:
1. Install transient voltage surge suppressor as indicated in manufacturer's installation instructions and in accordance with the applicable portions of NEC and in accordance with recognized industry practices to ensure that products comply with requirements.
2. The suppressor manufacturer or supplier shall specify recommended fuse type and ratings where Drawings show suppressor connections through fuses.
3. Provide engraved plastic nameplates.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior Luminaries.
B. Interior Luminaries.
C. Emergency Lighting Units.
D. Exit Signs.

1.2 REFERENCES

A. ANSI C78.379 - Electric Lamps - Incandescent and High - Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
B. ANSI C82.1 - Ballasts for Fluorescent Lamps - Specifications.
C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
D. ANSI/NFPA 70 - National Electrical Code
E. ANSI/NFPA 101 - Life Safety Code.
F. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
B. Product Data: Provide dimensions, ratings, and performance data.
C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, and installation of product.

PART - 2 PRODUCTS

2.1 Provide Fixtures and Accessories equal to items identified in the schedule on the Drawings. Holophane was used as a base line selection to get type and quality.

PART - 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
C. Install wall mounted luminaries, emergency lighting units and exit signs at height as indicated on Drawings.
D. Install accessories furnished with each luminaire.
E. Connect luminaries, emergency lighting units and exit signs to branch circuit outlets provided under Section 26-05-33 using flexible conduit.
F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
G. Bond products and metal accessories to branch circuit equipment grounding conductor.
H. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Aim and adjust luminaries as indicated on Drawings.

B. Adjust exit sign directional arrows as indicated.
C. Relamp luminaries that have failed lamps at Substantial Completion.

3.4 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.
B. Remove dirt and debris from enclosure.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

3.5 DEMONSTRATION

A. Provide minimum of two hours demonstration of luminaire operation.

END OF SECTION

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Materials.
2. Luminaire support.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Product Schedule: Refer to the Lighting Fixture Schedule for designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Refer to the Lighting Fixture Schedule included on the drawings for light fixtures specified for this project.

B. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event.

C. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

D. Altitude: Sea level to 1000 feet.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls or attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use Unistrut or tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements for material to be installed to connect safety and security devices shown and/or specified elsewhere.

1.02 INFORMATION SUBMITTALS

A. Product Data:
   1. Data for cable and hardware.
B. Test Reports:
   1. Factory Test Reports.

1.03 DELIVERY AND STORAGE

A. Test cables upon receipt at Project site.
   1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
   2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verity the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of FTP cable for open and short circuits.

1.04 ENVIRONMENTAL CONDITION

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
B. Environmental Limitations: Do not deliver or install FTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 – PRODUCTS

2.01 MATERIALS

A. FTP Cable and Hardware Basis-of-Design Product: Subject to compliance with requirements, products by the following manufacturers shall be considered equal where applied to the Basis of Design and Reference Part Number listed within this section.

   - AMP Netconnect; a brand of Tyco Electronics Corporation.
   - General Cable
   - Hubbell Premise Wiring
   - SYSTIMAX Solutions; a CommScope, Inc. brand.

   1. FTP Cable Description: 100-ohm, four-pair FTP, covered with an orange thermoplastic jacket.
      a. Comply with ICEA S-90-661 for mechanical properties.
      b. Comply with TIA/EIA-568-B.1 for performance specifications.
      c. Comply with TIA/EIA-568-B.2, Category 6.

      d. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

1) Communications, General Purpose: Type CM or CMG.
2) Communications, Plenum Rated: Type CMP, complying with NFPA 262.
3) Communications, Riser Rated: Type CMR, complying with UL 1666.
4) Communications, Limited Purpose: Type CMX.
5) Multipurpose: Type MP or MPG.
6) Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
7) Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2. Hardware:
   a. FTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
   b. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

B. Optical Fiber Cable & Hardware - Basis of Design Product: Subject to compliance with requirements, products by the following manufacturers shall be considered equal where applied to the Basis of Design and Reference Part Number listed within this section.

- Corning Cable Systems
- AMP Netconnect; a brand of Tyco Electronics Corporation.
- CommScope, Inc.
- General Cable Technologies Corporation.

1. Optic Fibre Cabu
   a. Description: Multimode, 50/125-micrometer, 2-fiber, nonconductive, indoor/outdoor, optical fiber cable with tracer wire.
      1) Comply with ICEA S-83-596 for mechanical properties.
      2) Comply with TIA/EIA-568-B.3 for performance specifications.
      3) Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
         a) General Purpose, Nonconductive: Type OFN or OFNG.
         b) Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
         c) Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
         d) General Purpose, Conductive: Type OFC or OFCG.
         e) Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
         f) Riser Rated, Conductive: Type OFCP, complying with UL 1666.
      4) Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
      5) Minimum Model Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
   b. Jacket:
      1) Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
      2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
2. Optical Fiber Cable Hardware:
   a. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
      1) Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

C. Low-Voltage Control Cable:
   1. Paired Cable: NFPA 70, Type CMG.
      a. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
      b. PVC insulation.

c. Unshielded.
d. PVC jacket.
e. Flame Resistance: Comply with UL 1581.

2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
a. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
b. PVC insulation.
c. Unshielded.
d. PVC jacket.
e. Flame Resistance: Comply with NFPA 262.

D. Identification Products:
1. Brady Worldwide, Inc.
2. HellermannTyton North America.
3. Kroy LLC.
4. Panduit Corp.

E. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.02 QUALITY CONTROL

A. Factory Test:
1. Test FTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
2. Test FTP cables according to TIA/EIA-568-B.2.
3. Test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

B. Cable will be considered defective if it does not pass tests and inspections.

PART 3 – EXECUTION

3.01 PREPARATION

A. Installation of Conductors and Cables:
1. Comply with NECA 1.
2. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

B. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B recommendations for separating copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.02 INSTALLATION

A. General Requirements for Cabling:
   1. Comply with TIA/EIA-568-B.1.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
   6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
   8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
B. FTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 designation rating of components and that ensure Category 6 designation performance of completed and linked signal paths, end to end.
   1. Comply with TIA/EIA-568-B.2.
   2. Install 110-style IDC termination hardware unless otherwise indicated.
   3. Do not untwist FTP cables more than ½ inch from the point of termination to maintain cable geometry.
C. Optical Fiber Cable Installation:
   1. Comply with TIA/EIA-568-B.3.
   2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
D. Open-Cable Installation:
   1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
   2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
   3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.03 SYSTEM

A. Firestopping: Comply with TIA-569-B, "Firestopping" Annex A. Comply with BICSI TDMM, "Firestopping Systems" Article.
B. Grounding: For communications wiring, comply with J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
C. Identification: Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
B. Perform the following tests and inspections:
   1. Visually inspect FTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test FTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical Fiber Cable Tests:
    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-End cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes products and requirements for Intrusion Devices.
B. Related Requirements:
   1. Electrical Division 26-nn-nn.
   2. Process Instrumentation 40-90-nn.

1.02 ACTION SUBMITTALS 01-33-00

A. Product Data: Provide Product Data showing manufacturer's specifications, electrical characteristics, and connection requirements for each Product supplied.
B. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer.

1.03 CLOSEOUT SUBMITTALS

A. O & M: Submit Operation Data: Maintenance Data shall include component parts diagrams and lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

1.04 QUALITY ASSURANCE

A. Regulatory:
   1. Conform to requirements of NFPA 70 National Electrical Code.
   2. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and as suitable for purpose specified, and as indicated on the Drawings.
   3. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
      a. ANSI/ISA applicable standards for measurement and instrumentation.
      b. NEMA, including 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.
B. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

1.05 SITE CONDITIONS

A. Environmental: Normal ambient temperatures at the Facility range from zero 0°F to 115°F.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Limit Switches (Mechanical Type):
   1. Mechanical limit switches shall be as manufactured by Allen Bradley, Cutler Hammer, Square D, or equal.
   2. Limit switches shall have the contract arrangement as shown on the Drawings or as required. Contacts shall be rated 6 amperes at 120 VAC. Enclosures shall be NEMA Type 4 or explosion proof as indicated on the Drawings.
B. Intrusion Detector:

1. The Intrusion Detector shall be model RX-40PI with Wall and Ceiling Mounting Bracket FA-3 as manufacture by Optex.
2. Each Detector shall:
   a. Shall operate on the Verified Intrusion principle using Passive Infrared (PIR), and shall be listed by Underwriter's Laboratories, Inc.
   b. Shall provide the sensing, signal processing, alarm relay, and operating power circuitry in the same enclosure; and shall provide an alarm relay actuation upon the detection of an intruder moving into or through its protection pattern. The enclosure shall be ready for surface and/or corner mounting to a compatible wall or ceiling mounting bracket without modification.
   c. Shall feature a single piece electronics board. The case shall include easy wiring knockouts and a wiring guide with wide wiring space.
   d. Shall incorporate a single, red LED to indicate the operating conditions: Red LED Illuminated shall indicate an alarm condition; Red LED not illuminated shall indicate a non-alarm condition. LED shall be able to be field disabled using an On/Off pin selector.
   e. Shall be capable of operating from a DC power source rated within the range of 9.5 to 16 volts DC, and shall draw a nominal 17 milli-amps (mADC) at 12 VDC.
   f. Shall contain a front mounted spherical Frensal lens that shall focus received infrared energy onto the sensor. The sensor shall construct a Wide Angle protection coverage field of 40 ft. x 40 ft. (12m x 12m), at 85° wide, with 78 detection zones.
3. PIR Detection: To accomplish PIR detection, each detector shall contain a sealed Pyro-Electric sensor. A condition of alarm shall occur when the PIR alarm conditions are met. The sensitivity shall be 3.6°F (2°C) at 2ft/sec. (0.6m/sec.). The detection speed shall be 1 – 5 ft/sec. (0.3 – 1.5 m/sec.). The pulse count shall be approximately 20 sec., and shall allow for a selection mode of 2 or 4 triggers to initiate an alarm output. Each detector shall signal the condition of alarm using a normally closed reed relay with terminal strip connections. The alarm output shall be capable of handling 28 VDC, 0.2 Amps max, N.C.
   a. PIR detection shall use Quad Zone Logic Signal Processing. Quad Zone Logic provides multi-segmented detection zones over the detection area. An alarm signal shall be created by the cumulated total IR energy of each zone. It is designed so that a human size target will normally fill 4 to 8 zones, and this shall cause an alarm to be generated. Any smaller temperature change shall only activate one or two zones at the same time, creating a much weaker detection signal. These signals shall be further analyzed for accurate detection of humans and avoidance of most small animals. Temperature Compensation Logic shall control sensitivity to improve stability against changes in environmental conditions.
   b. To guard against false activations caused by RF interference, the detector shall incorporate RFI protection capability. This circuitry shall adjust to background disturbances, in order to help reduce false activations while maintaining catch performance. No alarm shall occur at 20 V/m from 100 MHz to 1 GHz. To ensure proper circuit operation, the detector shall incorporate a PIR self-test with defaults. When the device is turned on, the warm-up period shall be approximately 30 seconds.
4. Mounting Height:
   a. Each detector shall be mounted between 5 – 8 ft. high.

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. Calibrate and/or verify each device for the ranges, spans, and setpoints indicated on the Drawings.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions, and Division 1 General requirements, apply to the work of this section.

1.02 WORK SUMMARY

A. The work of this section includes the furnishing of all labor, materials, tools, equipment and any other items necessary for the handling, mixing and injection of expansive grout waterproofing specified herein and/or shown on the project drawings.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product data, with complete general and specific installation instructions, recommendations, and limitations.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Contracting company should have a minimum of three (3) years experience in remedial grout injection waterproofing work of the type required by this section.

B. Pre-Installation Meeting: A pre-installation meeting shall be held prior to commencement of field installation to establish procedures to maintain required working conditions and to coordinate this work with related and adjacent work.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Deliver materials in factory sealed and labeled packaging. Sequence deliveries to avoid delays, while minimizing on-site storage. Handle and store following manufacturer's instructions, recommendations and material safely data sheets. Remove damaged material from site and dispose of in accordance with applicable regulations.

1.06 PROJECT CONDITIONS

A. Substrate Condition: Proceed with work only when substrate construction and preparation work is complete and in condition to receive expansive grout waterproofing.

1.07 WARRANTY

A. Contractor's Warranty: Upon completion and acceptance of the work required by this section, the Contractor will provide a written one (1) year workmanship warranty agreeing to repair or re-inject bentonite grout waterproofing if water penetrates the structure, within the performed work area, within the specified warranty period. Warranty period shall commence upon completion of injection work. This warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made under the Contract Documents.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide "Bentogrout" remedial waterproofing grout as manufactured by CETCO, Arlington Heights, Illinois 60004-1440. www.cetco.com

B. Provide hydrophobic foam as manufactured by AZON/USA, Inc., Kalamazoo, Michigan, www.azonintl.com

2.02 MATERIALS

A. Bentonite Grout
   1. Bentonite Grout consisting of bentonite clay and polymer blend specifically designed to seal below grade foundations, vaults, tunnels, and manholes. Grout material shall be flowable grade when mixed and set up to a moderate plastic consistency within eight hours.
   2. Mixing and Pump Equipment: Mixer, pumps, hose, injection pipe/packers and need assembly, pressure gages as recommended by the supplier/manufacturer.

B. Expansive Foam:
   1. Expansive Foam consisting of hydrophobic foam with Catalyst blended specially to seal underground vaults and tunnels. Hydrophobic foam shall be AZO Grout 424.
   2. Mixing and Pump Equipment: Mixer, pumps, hose, injection pipe/packers and need assembly, pressure gages as recommended by the supplier/manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION

A. The installer shall examine conditions of substrates and other conditions under which this section Work is to be performed and notify the Engineer, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

B. Prior to injection work, Owners/Engineer shall inform the Contractor and provide physical mark of the location of all underground utilities and structures that may be damaged by grout injection work.

3.02 WORK AREA PREPARATION

A. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing grout during mixing or installation operations.

B. Prepare any large cracks, joints, or voids on the interior surface of the structure so that the waterproofing grout is restricted from entering the structure during or after the injection operation.

C. Joints and cracks shall be water jetted at a water pressure of 500 to 1000 psi to remove laitenance and joint deposits.

3.03 BENTONITE GROUT INJECTION

A. Grout can be injected to the exterior of the foundation wall from interior tunnel without excavation and/or from the building interior via drilled holes through the foundation.

B. Interior Injection through drilling holes:
   1. Drill Holes: Drill injection holes through foundation wall at 3” to 6” above the floor level, spaced 3 to 4 feet on center. If water pressure exists, a temporary plug will need to be installed in drilled holes until grouting completed. Move up the wall in 3 to 4 feet (0.9 m to 1.2 m) increments and drill additional injection holes centered between the lower line holes to provide a diagonal shaped injection grid. Typical drilled hole diameter: 5/8” (15 mm).
   2. Grout Mixing shall be in accordance with the Supplier/Manufacturer’s recommendations. Mix until grout is thoroughly mixed with an even consistency.
   3. Grout Pumping: Starting at the lowest drilled holes, insert and set injection pipe in drilled hole. Pump properly mixed bentonite grout through injection pipe until a back pressure is achieved or grout returns through adjacent drilled holes. Typical pumping pressures range 20-80 psi. Actual pumping pressure will vary due to site and work conditions. Start injection process at low pressure and at slow volume for best result to track bentonite grout along exterior wall face.
      a. Upon achieving substantial backpressure or achieving grout return through adjacent drilled hole(s),

plug initial grouted hole, move to adjacent hole at bottom of wall, and continue pumping process. After completing a predetermined work area, move injection process to next row of injection holes up wall. Continue grouting process until entire foundation work area has been injected.

b. Pump grout within 45-minutes of mixing. During short delays in pumping, recycle grout through pump so that it does not set up in the hose. Position pump close to injection points to minimize pressure loss in hose.

4. After grouting, properly seal drilled injection holes at interior face of foundation wall with high strength, non-shrink cementitious grout.

3.04 FOAM GROUT INJECTION

A. Interior Injection through drilling holes:

1. Drill Holes: Drill injection holes through wall at 3" to 6" above the floor level, spaced 3 to 12 inches on center alternating sides of joint/crack. If water pressure exists, a temporary plug will need to be installed in drilled holes until grouting completed. Move along the joint/crack in 3 to 4 feet (0.9 m to 1.2 m) increments and drill additional injection holes centered between the lower line holes to provide a diagonal shaped injection grid. Flush packer location with water and 10% muratic acid. Typical drilled hole diameter: 3/8".
2. Grout Mixing shall be in accordance with Manufacturer's recommendations. Mix until grout is thoroughly mixed with an even consistency. Grout mixture has a "pot life" of 60 minutes.
3. Grout Pumping: Starting at the lowest drilled holes, insert and set injection packers and zerc fitting in drilled hole. Pump properly mixed expansive foam through injection points. Actual pumping pressure (300 psi minimum) will vary due to site and work conditions. Start injection process at low pressure and at slow volume for best result to track bentonite grout along exterior wall face.
   a. Upon achieving substantial backpressure or achieving grout return through adjacent drilled hole(s), plug initial grouted hole, move to adjacent hole at bottom of wall, and continue pumping process. After completing a predetermined work area, move injection process to next row of injection holes up wall. Continue grouting process until entire foundation work area has been injected.
   b. Pump grout within 45-minutes of mixing. During short delays in pumping, recycle grout through pump so that it does not set up in the hose. Position pump close to injection points to minimize pressure loss in hose.
4. After grouting, properly seal drilled injection holes at interior face of foundation wall with high strength, non-shrink cementitious grout.

3.05 CLEAN UP

A. Clean up and discard extra grout from completed work area, daily and end of project. Do not leave any grout or grout residue on pedestrian or vehicular traffic surfaces. Remove all tools, equipment, remaining product and work debris on-site. Dispose of debris following all applicable regulations.

1. Joint surface and injection points shall be scraped level and flush with the surface.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes material specifications for items to be incorporated in the Work for the General Division Earthwork.
B. Related Requirements: Technical Specification 31-nn-nn

1.02 REFERENCES

A. Definitions:
1. Aggregates: Aggregates are natural aggregates originating geologically from stone quarries, gravel, or igneous/metamorphic rock deposits.
2. Granular Material: Granular materials for use as fill, trench backfill, and subbase shall consist of natural sand, gravel, crushed stone, and iron blast-furnace slag. Foundry sand or fly ash will not be permitted.
3. Sand: Sand (fine aggregate) are fine granular material resulting from the natural disintegration of rock.
4. Excavated Materials are soils excavated at the specific project site.
5. Select imported backfill.

B. Reference Standards:
1. Standard Specification for Construction: "Michigan Department of Transportation" 2012 Standard Specifications for Construction Tables 902-1,902-2, 902-3 and 902-4.
2. Uniform Soil Classification System ASTM D2487.

1.03 INFORMATIONAL SUBMITTALS

A. Test Reports or Certification when required by specific specifications.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregates:
Aggregates may be Gravel, Stone or Slag meeting MDOT physical requirements and shall conform to the following class and gradations:

	Sieve analysis		Total Percent Passing								Loss by Washing (LBW)		
Mark	3 in.	2.5 in	2in	1.5in	1in	3/4in	1/2in	3/8in	#4	#8	#30	#100	Lbw
3x1(1)	100	99	97-99	71-97	15-71	4-15	3-4	3-2	--	--	---	---	2
4A	----	100	90-100	40-60	-	0- 12	--	--	--	--	--	--	2
6A	----		---	100	95-100	---	30-60	--	0-8	--	---	---	1
34R	--		---	---	---	---	100	90-100	--	0- 5	---	---	3
3x1(2)	100	90-100	90-60	60-30	30-5								
#4(3)	--	--	100	90-100	20-5	50-15	-	0-5					

(1) Levy Slag
(2) Limestone – Stoneco
(3) ODOT - Stoneco

B. Fine Aggregates- Sand:
1. 2NS; passing sieve: 3/8" through No. 100, MDOT 2NS.
2. 2MS; passing sieve: No. 4 through No. 100, MDOT 2MS
C. Granular Material:
1. Class II; passing sieve: 3" through No. 100.

D. Excavated Material – Acceptable:
1. Well-graded to poorly-graded clean gravels, gravels with fines, clean sands, sands with fines or gravel-sand mixtures (that is, soil mixtures classified in the Uniform soil classification system, ASTM D2487, as group symbols GW, GC, GM, GC, SW, SC or combination thereof).
2. Free from particles exceeding 2" in largest dimension, lumps of fine-grained soils, construction debris, topsoil, organic matter, frozen material and other deleterious materials and capable of being compacted to the required density.

E. Select imported backfill:
1. Imported clean fill material shall be clean, natural soil certificates that are uncontaminated and free of clay rods greater than 12", rock or gravel greater than two (2) inches in any dimension, debris, waste, and other deleterious material. Slag, bottom ash, and foundry sand are not acceptable.

F. Flowable Fill: A transit mixed blend of Sand, 2MS or 2NS; Portland Cement, type I; and fly ash, class C.or F.
Mixture: .. A transit mixed blend of Sand, 2MS or 2NS; Portland Cement, type I; and fly ash, class C.

Mixture, by Volume..	60	1	20
By weight..	50	1	10

G. Geo Textiles:
1. Geotextile Separator for Foundation Bedding:
   a. non woven: puncture: 1400 lbs; tear; 200 lb; weight; 12 oz / syd
   b. CSI Geoturf H4800
2. Geotextile for Rip rap;
   a. woven with ultraviolet inhibitor
      - puncture: 725 lbs; tear: 100 lb; weight: 10 oz. / syd
   b. CSI Geoturf N1000E
3. Geotextile Silt fence :
   a. produced product for use as a silt fence
   b. grab tensile strength; 100 psi;
   c. trapezoid strength; 45 lbs
   d. water flow rate; 30 gal/min/sq.ft.

H. Geo grids:
1. {Presto Products; GW 30V, or
2. Tenstar BX 1100.

2.02 PRODUCT USES

Unless noted otherwise, on the drawings, materials shall be used as listed for specific items of Work below:

Item of Work/	Mark/aggregate type				
Specification	3x4	4A	6A	34R	Gran II
Foundation bedding;	…..	X	X		
Stabilize subgrade;	X	X	….		
Temporary Roadway;	X	X	….		
Pipe bedding/backfill:	….	….	X	X	X
Trench backfill:	…..	….	….	X	X
Electrical Conduit	…..		…..	X	

END OF SECTION

SITE EARTHWORK

CLEARING SITE
Section 31-12-13

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes requirements and materials clearing proposed pathway/walkway routes for base preparation and wearing surface construction.
B. Related Requirements:

1.02 SITE CONDITIONS

A. Existing Condition:
   1. Protection of Existing Improvements:
      a. Protection improvements on adjoining properties as well as those on the Owner's property.
      b. Restore any improvements damaged by this work to their original condition, as acceptable to the Owner or other parties or authorities having jurisdiction.
   2. Protection of Existing Trees and Vegetation:
      a. Protect existing trees and other vegetation included in the Drawings to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stock piling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fill material shall be Granular Class II or equal.

PART 3 – EXECUTION

3.01 CLEARING

A. Limits of clearing shall be all areas within the subbase limits as indicated on the Drawings. Remove trees (3" and smaller), saplings, shrubs, bushes, vines, roots and undergrowth within (2") two inches of ground surface within the limits of clearing. Do not remove trees and other vegetation indicated on the Drawings to remain in place.
B. Tree Removal (Read):
   1. Chipping: All logs, stumps, roots, cuttings and other material resulting from clearing operations shall be chipped on site at locations as directed and remain on from the site.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes removal of tree and stump as noted on the drawing.
B. Related Requirements:
   1. Common Materials for Earthwork 31-05-10.

1.02 REFERENCES

A. Definitions:
   1. Tree diameter, size shall be measured at breast height (4.5 feet above base of tree.
   2. Where more than one tree has grown from a common stump, each tree will be considered as a separate tree.
   3. Tree removal includes removal of the stumps.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Stump Backfill Material shall be Class II.
B. Excavated Material

PART 3 – PREPARATION

A. If removal of a stump may result in damage to existing utilities, remove the stump by chipping to a depth of at least 12 inches below the finished ground surface. Remove other stumps by chipping only when approved by the Engineer.

3.02 REMOVAL AND DISPOSAL

A. Removing Trees and Stumps: Remove and dispose of designated trees or stumps within the work area that are 6 inches or larger in diameter. Remove and dispose of trees, stumps, roots and debris off-site.
   1. Trees shall be chipped on site of designated area.
   2. Stumps shall be removed off site
B. Void created by the tree stump removal shall be backfilled and leveled with material as follows.
   1. Sand/Granular material shall be placed and compacted for areas within the roadway paving and/or building outline.
   2. Excavated material shall be placed and leveled in areas outside of roadway/paving and or building outlines.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirement for “Stripping and Stockpiling”.
B. Topsoil shall become the property of the Contractor except for quantities used for site replacement topsoil. Excess topsoil shall be removed at completion of the project.
C. Excavated Material:
   1. Shall become the property of the Contractor except for quantities used for site backfill.
   2. Excess Excavated Material shall be removed at completion of the project.

1.02 QUALITY ASSURANCE

A. Retain land surveyor to establish specific contract location and elevations for site grading.
   1. Subgrade and finish grade locations shall be established.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

A. Establish stockpile limits:
   1. Review limits of work and drainage structure.
B. Before removing topsoil, reduce all vegetation to a height of approximately 6 inches. Remove and dispose of all cut vegetation, brush, rocks, and other litter.

3.02 STRIPPING AND STOCKPILING

A. Removing:
   1. Remove topsoil to the required depth from designated areas before excavating or placing embankment. Use equipment and methods that avoid lifting subsoil. Suspend topsoil removal if soil or weather conditions are unsuitable.
   2. Remove topsoil within the grading limits.
   3. Screen topsoil to remove roots, shredded brush rock, vegetation greater than ½” in size.
B. Stockpiling:
   1. Locate and shape stockpiles outside of the drip line of preserved trees. Locate topsoil stockpiles away from drainage courses and wetlands.
   2. Stockpile topsoil from the roadway within the right-of-way and outside the limits of construction or use in the slopes.
   2. After removal of the l stockpiles:
      a. Grade the site.
      b. Seed and mulch.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirement for site excavation and site grading to prepare earth subgrade for topsoil and/or aggregate subsequent placement.
B. Excavated materials shall become the property of the Contractor except for quantities approved for use as acceptable backfill.

1.02 REFERENCES

A. Reference Standards:
1. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft (T-99).

1.03 QUALITY ASSURANCE

A. Retain land surveyor to establish specific contract location and elevations for site grading.
1. Subgrade and finish grade locations shall be established.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

A. Establish cut and fill grades:
1. Review limits of work and drainage structure.

3.02 GRADING

A. GENERAL
1. Grade all areas within contract limits outside building, structures and hard surface improvements (such as paving, concrete slabs and the like).
2. Perform all necessary earth moving, dozing and grading of soil material to provide a surface within the specified tolerances, free of voids and soft spots.
3. Provide uniform levels or slopes between given points or between such points and existing grades.
4. Provide grading for positive drainage and erosion control.
5. Hand grade areas adjacent to exterior of building and structures to drain away from the structure and to prevent ponding of water.

B. Earth Excavation:
1. Compact the subgrade to not less than 95 percent of Standard Proctor to a depth of at least 10 inches. If the subgrade cannot be compacted to 95 percent of Standard Proctor, using conventional construction methods, the Engineer may authorize use of other methods to attain compaction.
2. Maintain the roadbed and ditches and keep well drained at all times. Installing and removing temporary drainage facilities will be at the Contractor's expense.
3. Conduct grading to avoid removing or loosening material outside the required slopes. If material is removed, or loosened outside the required slopes, replace and compact to the required density and cross section.

C. Machine Grading:
1. Machine grading consists of grading for an approximate depth of 12 inches. This work includes scarifying, plowing, disking, moving, compacing, and shaping the earth to develop the cross section shown on the plans. Grade ditches to drain runoff waters. Grade all intersections, approaches, entrances, and

driveways as shown.

2. Grade to subgrade elevation of ¾ inch (0.05 ft) ±.

D. Trimming and Finishing Earth Grade: (Topsoiling and Pathways)

1. Construct the earth grade to the required grade and remove all exposed stones and rocks more than 3 inches in diameter.
2. Where trees or other restrictions do not interfere, round the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section to form vertical curves as shown on the plans or as directed.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included in this Section: Perform structural excavation, backfill and compaction indicated on the Drawings or specified herein.

B. Related Requirements:
   1. Testing Laboratory Services: Section 01-45-23.
   2. Submittals: Section 01-33-00.
   3. Common Material for Earthwork: Section 31-05-10.

1.02 REFERENCE

A. Reference Standards:
   1. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf /ft (T-99).
   2. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56000) ft-lbf/ft (T-180).

1.03 INFORMATION SUBMITTALS

A. Source of Materials: Submit the source of borrow and granular materials proposed for the work, giving location, and as applicable, name and address of supplier.

1.04 QUALITY ASSURANCE

A. Quality Control: The testing laboratory services provided under Section 01400 will perform the following:
   1. Field Density Tests:
      a. Determine by nuclear methods (ASTM D6938).
      b. Make field density tests or compacted sub grade soils on basis of 3 tests plus one additional test per 10,000 sq. ft. area or fraction thereof.
      c. Make 3 field density tests of each lift of compacted fill or backfill placed each day.

PART 2 – PRODUCTS

2.01 MATERIAL

A. Materials shall be listed in Section 31-05-00 Common Materials for Earthwork.
   1. Aggregate 6A or 3G.
   2. Granular Material – Class II.
   3. Excavated Material – Acceptable.

PART 3 – EXECUTION

3.01 METHODS OF OPERATION

A. Determine the method of operation for this work and be solely responsible for the effect of same and for soil movements, or disturbance, which may take place, and for all damages to structures, construction, or other operation. Side slopes and sheeting shall be such as the Contractor may elect after due consideration of soil stability, conditions to be encountered, or codes.

3.02 EXCAVATION

A. General:
   1. Excavation shall include removal, hauling and disposal of all classes of materials and obstructions encountered for work specified.
   2. Perform excavations with sufficient space to permit placing and removal of concrete formwork and bracing, installation of other work shown, and inspection.
   3. Excavation for footings may be accurately made to the lines of footings where nature of soil will permit, or to the limits indicated on the Drawings; otherwise allow for forms.
      a. In excavation for footings and foundations, take care not to disturb bottom of excavation.
      b. Trim, level and clean excavation bottoms just prior to placing concrete.
   4. No concrete for foundation work shall be placed until soil bearing capacity has been verified and the soil conditions have been approved.
   5. Subaqueous Excavation:
      a. Excavation of insitu material rear of retaining walls containing water shall occur to elevations indicated on the drawings.

B. Shoring and Bracing: Provide and maintain shoring, bracing, sheet piling, and other temporary work as required to contain banks of excavation, or to support existing construction during fill or backfill placement and compaction. Remove such shoring and bracing when no longer required, except as otherwise approved.

C. Removal of Unsatisfactory Soil Materials: Remove all unsatisfactory soil materials encountered at bearing elevations. Fill the space under footings and foundations with backfill and compact backfill materials as specified hereinafter for excavations of the same classification.

D. Unauthorized Excavating: If excavations are carried below the indicated level without being so directed, or unsatisfactory conditions caused by the Contractor's operations require extra excavation, the Contractor shall fill these areas with flowable fill at his own expense.

E. Storage of Satisfactory Excavated Materials: Stockpile excavated material classified as "Excavated Material – Acceptable" on the project site until required for fill, backfill, or rough grading. Place, grade and shape stockpiles for proper drainage.

F. Disposal of Waste Excavated Materials: Promptly remove as the work progresses all waste materials resulting from excavating operations and remove excess satisfactory excavated material, and legally dispose of off the Owner's premises.
   1. Trucking:
      a. The trucks hauling the dredged [subaqueous] material shall have gasketed tailgates and be otherwise watertight so as not to lose water or dredge material during transport.
      b. Truck track-out or truck spills from the operation onto the Owner's property or onto the City streets will not be allowed. If track-out or spilling occurs, the Contractor shall be responsible for cleaning the area in the manner described as directed by the Engineer.

3.03 FILLING AND BACKFILLING

A. Preparation Prior to Filling or Backfilling:
   1. Fill and backfill excavations promptly as the work permits, but not until the following:
      a. Approval of construction below finish grade.
      b. Inspection, testing, approval, and recording location of underground utilities.
      c. Removal of concrete formwork.
      d. Removal of shoring and bracing.
      e. Removal of trash and debris.

B. Placing Fill and Backfill Materials:
   1. Schedule filling and backfilling to expedite construction progress and to maintain positive site drainage.
   2. Backfill after foundation walls have been completed and have attained proper strength.
   3. Backfill in manner to prevent excessive pressure against work-in-place.
   4. Place fill and backfill material in uniform layers of thickness commensurate with the soil material and

compacting equipment used. Compact in true planes at correct elevations.

C. Compaction:
1. Compact soil material with equipment suitable for the soil material being compacted and the location of the work relative to other construction and capable of obtaining the required percentage maximum density throughout the entire layer of soil material.
2. Prior to compacting soil material having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.
3. Do not flood soil material in place.
4. Suspend compaction operations when weather conditions or other unsatisfactory conditions make it impossible to obtain satisfactory results.

D. Fill and Backfill and Percentage Maximum Density Requirements:
1. Under Foundations: Fill or backfill under concrete foundations for building from surface to underside of foundation with Granular Material, place in 12 maximum layers, and compact to Modified Proctor Test 95% maximum density.
2. Within Building Walls: Backfill excavations within building walls with Granular Material to underside of fill under concrete floor slab-on-ground, place in 12” maximum layers, and to compact to Modified Proctor Test 95% maximum density.
3. Floor Slab-on-Ground: Fill under concrete floor-slab-on-ground within building walls from surface of subgrade or backfill, as applicable, to underside of concrete floor slab-on-ground with Granular Material, place in 12” maximum layers, and compact to Modified Proctor Test 95% maximum density.
4. Outside Building under Paving Areas: Backfill excavations outside building under areas to receive bituminous or Portland cement concrete paving with Granular Material to underside of paving base course, place in 12” to 18” maximum layers, compact to Standard Proctor Test 95% maximum density.
5. Outside Building Under Lawn Areas: Backfill excavations outside building area with material placed in 18” to 24” layers, and compact to Standard Proctor Test 80%.

3.04 GRADING

A. General: Grade backfill and fill materials placed under this Section to provide a smooth surface within the specified tolerances, free of voids and soft spots, and compacted.

B. Areas within Building Walls: Shape surface of fill or backfill within building walls to line and grade to within plus-or-minus ½” of subgrade elevation indicated for underside of concrete floor slab-on-ground when tested within a 10-foot straight-edge applied both parallel to, and at right angles to the walls enclosed the area.

C. Areas Adjacent to Exterior of Structures: Hand grade areas adjacent to exterior building walls and other structures to drain away from the building or structure and to prevent ponding of water.

3.05 CLEANING

A. Make every effort to keep streets, roads and drives free from waste material resulting from earthwork operations. Clean such surfaces as required, or when directed, to eliminate any waste material deposited.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section discusses furnishing, installing and operating a temporary Deep Well or Well Point pumping system to lower the groundwater. The dewatering system shall be adequate to pre-drain the water bearing strata above and below the bottom of the drains, sewers, and all other excavations to prevent boils and quick conditions, and to maintain the stability of sides and bottoms of excavations.

B. Related Requirements:
   1. Soil Erosion and Sedimentation Control: Section 01-57-00.
   2. Measurement and Payment: Section 01-22-00.

1.02 SITE CONDITIONS

A. The Contractor shall determine to what extent, if any, variations in surface water levels and underground water levels may affect the work under this Contract. It is the intention of these Contract Documents that all work shall be performed in the dry and that means and methods shall be employed by the Contractor to protect the work as necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 EQUIPMENT

Provide complete standby equipment, available for operation as may be required to maintain the dewatering system in the event that all, or a part of, the dewatering system becomes inadequate or fails.

A. Equipment selection shall be the contractor's choice.

B. The noise levels of all equipment operating during nocturnal hours shall meet stage II noise requirements:
   1. Engine direct drive units shall be baffled/enclosed to maintain a sound level of less than 69 dBA at 23 ft.
   2. Engine electric generators shall be baffled/enclosed to maintain a sound level of 65 dBA at 23 ft.

2.02 MATERIALS

A. Geo-Textiles:
   1. Filter bags shall be 6 ft. x 6 ft. or 15 ft. x 18 ft. size "Ecolobag", Non-Woven Textile. Material shall meet the following:
      a. Flowrate: 140 gpm/sq. ft.
      b. Permitivity: 2.0 sec-1
      c. Opening size: 70 us std.
   2. Inlet Filters shall be fabricated filter traps similar to "Catch-all". Assembly shall consist of steel frame with mesh outer reinforcement and a replaceable inner filter fabric. Fabric shall meet the following:
      a. 145 gpm
      b. 2.1 sec (-1)
      c. 0.212
   3. Vendor: HanesGeo.com, Wixom, Michigan.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All pumping shall be done without damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other Contractors.

B. Piping placed across driveways to residences/businesses shall be lowered or gravel shall be placed to “ramp” over the piping.

3.02 SYSTEM OPERATION

A. The Contractor shall take all necessary precautions to assure that no raw sewage is by-passed to a receiving stream as a result of his operations.

B. Discharge of the pump water shall pass through a:
   1. “Tank separator” prior to discharge to the R.O.W.
   2. “Filter bag” prior to discharge to a lake or stream.
   3. “Inlet filter” prior to discharge to a storm sewer manhole culvert.

C. Filter bag and inlet filters shall be checked daily and replaced as necessary.

3.03 CLEAN-UP / CLOSEOUT

A. The Contractor shall remove the dewatering system when the trench excavation is filled.
   1. After pipe headers well point piping and/or deep well works are removed, the voids shall be filled and rodded with site material/fill.
   2. Deep well shafts shall be sealed at the lower aquifer with Bentontite seal, thus filled with site material.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes requirements and materials for excavating and backfilling of utility pipeline, sewer, water main and appurtenances and placement.
   1. Special foundation [trench stabilization] at the trench bottom below the pipe bedding, if shown on the drawings, is specified elsewhere.

B. Related Requirements:
   1. Common Materials for Earthwork 31-05-10.
   2. Utility Division 33-00-nn.

1.02 REFERENCES

A. Definitions
   1. Backfill is the specified material to be placed in the excavation for the facility.
   2. Pipe Bedding is the material below and around/above the piping installed as shown on the drawings and as specified for the respective pipe being constructed
   3. Pipe Foundation.
   4. Paved surfaces.

B. Reference Standards:
   1. American Society Testing Material – ASTM.
   2. American Association of State Highway and Transportation Officials – AASHTO.
   3. Michigan Department of Transportation – MDOT.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notification to “MISS DIG” utility marking agencies.
   2. Notification to Owner regarding excavation.

1.04 ACTION SUBMITTALS

A. Product Data:
   1. Source of Materials: Submit source of borrow material, aggregates and granular material proposed for the work, giving location, and as applicable, name and address of supplier.
   2. Test Reports: When excavated material is proposed for backfilling under paving, driveway surfacing and adjacent area, submit test reports, performed by an independent laboratory testing service approved by the Engineer, indicating the proposed backfill material’s conformance with the requirements specified excavated material acceptable.

1.05 SITE CONDITIONS

A. Existing Conditions:
   1. Surface and Underground Hydrology:
      a. The Contractor shall determine to what extent, if any, variations in surface water levels and underground water levels may affect the work under this Contract.
      b. All work shall be performed in the dry and that means and methods shall be employed by the Contractor to protect the work as necessary at no additional cost to the Owner.
   2. Dewatering:
      a. Where the work is in ground containing an excessive amount of water, the Contractor shall provide, install and maintain an adequate dewatering system in order to permit under relatively dry conditions the performance of excavation, construction of the pipelines and related work, and

placement of backfill.

b. Dewatering outlets shall be approved by the Engineer.

3. Pumping, Maintaining Sewage Flow and Trench Drainage:

a. Adequate pumping and drainage facilities shall be provided and all water from whatever sources entering the work during any stage of construction shall be promptly removed and disposed of. All pumping and drainage shall be done without damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic, or the work of other Contractors. Dewatering shall be done in such a manner that the soil under or adjacent to existing structures shall not be disturbed, removed or replaced.

b. Both the dry weather and storm flows in all existing sewers ditches, streams, rivers and drains, which may in any way be affected by the new construction, shall be adequately maintained.

c. All gutters, ditches, catch basins, and other surface water inlets and drains shall be kept clear for proper surface drainage.

B. Protection: Provide and maintain barricades, warning signs, warning lights and other protection required by applicable laws, regulations and safety codes for safety of persons and protection of property during earthwork operations.

PART 2 – PRODUCTS

2.01 MATERIALS (Section 31-05-10)

A. Foundation: 3 x 1, 32G or 6A Aggregate.

B. Pipe Bedding Encasement: 34R [pea stone] or granular CLII.

C. Backfill:

1. Class II Granular or “Acceptable Excavated Material” shall be used for all trench locations under adjacent to existing and proposed paved surfaces, sidewalks.

a. Additionally, above materials shall be used when a portion of the trench is within the 1 on 1 slope line influences of paved surfaces.

2. Excavated material meeting the following requirements may be used areas excluding paved surfaces and building foundations.

a. Material shall be free from particles exceeding 3” in largest dimension, lumps of fine-grained soils, cinders, ashes, refuse, debris, topsoil, organic matter, and other deleterious materials and capable of being compacted to the required percentage maximum density by the compacting equipment to be used.

3. Flowable fill shall be used for trenches under proposed or existing building foundation and other transverse pipeline line crossings.

2.02 QUALITY CONTROL

A. Field:

1. Compact soil materials by compacting equipment suitable for the soil material being compacting and the location of the work and capable of obtaining the required percentage maximum density throughout the entire layer of soil material.

2. Prior to compacting soil material having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.

3. Suspend compaction operations when weather conditions or other unsatisfactory conditions make it impossible to obtain satisfactory results.

B. Compaction Testing:

1. Compact soil material to the required percentage maximum density as determined by the Standard Proctor Test (ASTM D698/AASHTO T-99), as specified, for soil materials having a well-defined moisture-density relationship curve.

PART 3 – EXECUTION

3.01 PREPARATION

A. Pavement Removal:
1. Removal shall be per RCOC Standards. Remove pavement to a minimum width of 6’ and at least 1’ wider than excavation.
a. Where Portland cement concrete is to be removed , the remaining slab width from the patch to an existing joint shall be a minimum of 5’. Cut concrete pavement by sawing to a minimum depth of 5”.
b. Where bituminous concrete pavement, cut pavement by sawing, unless otherwise approved by the Engineer.
c. If repair area is less than 4’-0” from joint then remove to joint.
d. 18” #6 epoxy-coated rebar at 1’-0” for all concrete pavement joints.
2. Make all saw cuts in a straight line and parallel to existing transverse and longitudinal joints, unless otherwise approved by the Engineer.

B. Shoring and Bracing:
1. Provide and maintain shoring, bracing, sheet piling and other temporary work as may be necessary for the safety and protection of the work, public or adjacent property.
2. Remove such shoring and bracing when no longer required, unless otherwise approved by the Engineer. Fill voids left by removal of shoring and bracing with sand, compacted in place.
3. Left in Place Shoring and Bracing:
a. Leave in place shoring and bracing indicated on the Drawings or specified to be left in place, or directed by the Engineer.
b. Cut off all shoring and bracing left-in-place at least 5’ below final grade.
c. Whenever the Engineering, in writing, orders bracing to be left in place, such shoring and bracing will be paid for by the Owner.
d. Shoring and bracing left in place by the Contractor shall be at no cost to the Owner.

3.02 EXCAVATION

A. Trench Excavation:
1. Begin trench excavation at the outlet and proceed toward the upper end.
2. Excavate trench so that the conduit can be laid to the alignment and grade indicated on the Drawings.
3. Excavate trench bottoms below the pipe invert a sufficient distance to provide space for the pipe bedding as specified under the Specifications Section covering the kind of piped utility system.
4. Maximum width of trench at top of pipe shall be as follows:

Pipe Outside Diameter (O.D.)	Trench Width
Up to 12”	30”
15” through 30”	Pipe O.D. plus 18”
36” and larger	Pipe O.D. plus 24”

a. If maximum trench width specified, above, is exceeded, construct a type of approved bedding to provide support for the additional load.
b. When sand, or coarse aggregate, or coarse aggregate-sand bedding material is to be used, maintain the maximum trench widths to permit compaction of the bedding material around the pipe.
c. When pearock or angular stone bedding material is to be used, provide a minimum of 6” clearance on each side of the pipe.
5. Depth of trench over water lines shall provide a minimum cover over top of pipe of 5’.

6. Remove ledge rock, particles over 2" in least dimension and other obstructions to provide a minimum clearance of 6" at bottom and sides of pipe.

B. Excavation for Utility Appurtenances:
1. Perform excavations with sufficient space to permit placing of precast concrete sections, placing and removal of concrete formwork (if any) installation of other work, and for inspection.
2. Excavation for cast-in-place concrete foundations shall be made to the foundation lines where the nature of soil will permit; otherwise allow for concrete forms.

C. Removal of Unstable Soil Materials:
1. Remove all unstable soil materials encountered at bottom elevation of excavations.
2. Fill excavations for unstable soil materials to elevation of bottom of excavations with "Foundation aggregates" and compact.
3. The cost of such excavation, filling, and disposal of unstable soil materials to 12" below bottom of the proposed pipe bedding shall be paid for by the Contractor.
4. Such excavating, filling, and disposal of unstable soil materials in excess of 18" below bottom of the proposed pipe bedding will be paid for by the Owner.
5. Where unstable soil materials below bottom elevation of excavations is unstable to such a degree that it cannot be removed and replaced with " Foundation Aggregate" as specified in this Paragraph, the Contractor shall cease work abed notify the Engineer.

D. Unauthorized Excavation: If excavations are carried below the required bottom elevations without being so directed by the Engineer, or unstable soil conditions caused by the Contractor's operations require extra excavation, fill such excavations and backfilling will be at no cost to the Owner.

3.03 EXCAVATED MATERIAL

A. Storage of Excavated Material:
1. Stockpile excavated material classified as "Acceptable Excavated Material" as may be required, in an orderly manner a sufficient distance from the banks of excavations to avoid over-loading and to prevent slides or cave-ins.
2. Pile such excavated material on side of excavations to permit ready access to and use of existing fire hydrants, shut-off valves, and other utility services and not to obstruct surface drainage of adjacent areas.

B. Disposal of Waste and Excavated Materials: Promptly remove, as the work progresses, all waste materials resulting from excavation operations and remove excess excavated material classified as Class A or B Trench Backfill Material, and legally dispose of off the Owner's premises.

3.04 BACKFILLING:

A. General:
1. Backfill trench excavations from top of pipe bedding encasement with materials as specified under Paragraph 2.01.C. to finish grades, unless otherwise specified.
2. Backfill excavations for utility appurtenances using granular CLll from bottom of foundation elevation to finish grade, unless otherwise specified.
3. Backfilling shall follow no further than 100' behind pipe laying.

B. Preparation Prior to Backfilling:
1. Backfill excavations promptly as the work permits, but not until the following:
   a. Approval of construction below finish grade.
   b. Inspection, testing, approval and recording location of underground utilities.
   c. Removal of concrete formwork.
   d. Removal of shoring and bracing or cutting off shoring and bracing to be left in place, as applicable.
   e. Removal of trash and debris.

C. Placing Backfill Materials:
1. Schedule backfilling to expedite construction progress and to maintain positive site drainage.

2. Backfill after cast-in-place concrete or masonry construction, or both, has attained proper strength.
3. Place backfill material in uniform layers of thickness not exceeding one (1ft). commensurate with the soil material and compacting equipment used.

D. Backfilling Under Paving, Surfacing and Adjacent Areas:
1. Backfill trench excavations with place in maximum layers, compact to Standard Proctor Test 95% maximum density.
2. Backfill utility appurtenances excavations within 3' of utility appurtenance (such as manholes and the like) with granular CLII, place in 12" maximum layers, compact to 95% maximum density.
3. Except under walks or where noted, bring backfill up to 10-1/2" below original paving surface. See detail.
4. Under walks, bring backfill up to 2" below original walk grade.

E. Backfilling Under Areas Outside of Sidewalk, Paving and Under Grassed Areas:
1. Backfill trench excavations with Class B Trench Backfill Material, place in 18" maximum layers, compact to approximately same density as adjacent soil-in-place but not less than 95% maximum density.
2. Backfill utility appurtenance excavations within 3' of utility appurtenance with Sand or Class 2 Granular Material, place in 12" maximum layers, compact to approximately same density as adjacent soil-in-place but not less than Relative Density Test 55% maximum density or Standard Proctor Test 70% maximum density.
3. Mound backfill material to allow for settlement and later grading to conform to original levels and appearance.

F. Backfilling in Freezing Weather: No frozen material shall be buried more than 4' below the final elevation of ground.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included in this Section: Perform structural embankment, backfill and compaction indicated on the Drawings or specified herein.

B. Related Requirements:
   1. Testing Laboratory Services: Section 01-45-23..

1.02 REFERENCE

A. Reference Standards:
   1. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf /ft (T-99).
   2. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56000) ft-lbf/ft (T-180).
   3. Standard Specification for Construction: "Michigan Department of Transportation" 2012 Standard Specifications for Construction Tables 902-1,902-2, 902-3 and 902-4.

B. Definitions:
   1. Aggregates: Aggregates are natural aggregates originating geologically from stone quarries, gravel, or igneous/metamorphic rock deposits.
   2. Granular Material: Granular materials for use as embankment fill, and subbase shall consist of natural, sand, gravel, crushed stone, and iron blast-furnace slag. Foundry sand or fly ash will not be permitted.

1.03 INFORMATION SUBMITTALS

A. Source of Materials: Submit the source of borrow and granular materials proposed for the work, giving location, and as applicable, name and address of supplier.

1.04 QUALITY ASSURANCE

A. Quality Control: The testing laboratory services provided under Section 01400 will perform the following:
   1. Field Density Tests:
      a. Determine by nuclear methods (ASTM D6938).
      b. Make field density tests on compacted sub grade soils on basis of 3 tests plus one additional test per 10,000 sq. ft. area or fraction thereof.
      c. Make 3 field density tests of each lift of compacted fill or backfill placed each day.

PART 2 – PRODUCTS

2.01 MATERIAL

A. Aggregates:
   Aggregates may be Gravel, Stone or Slag meeting MDOT physical requirements and shall conform to the following class and gradations:

	Sieve analysis	Total Percent Passing									Loss by Washing (LBW)
Mark	3 in.	2in	1.5in	1in	3/4in	1/2in	3/8in	#4	#8	#30	#100	Lbw
Coarse Aggregates;												
21A	----	---	100	85-100	---	50-75	---	----	20-45	----	---	4-8
21AA (a)	----	---	100	85-100	---	50-75	---	----	20-45	----	---	4-8
22A	----	---	---	100	90-100	---	60-85	---	30-50	---	---	4-8

   (a) crushed material 95% minimum

B. Granular Material:
   1. Class II; passing sieve: 3" through No. 100.

C. Geogrid:

1. Tensar “TX160” or equal

PART 3 – EXECUTION

3.01 METHODS OF OPERATION

A. Determine the method of operation for this work and be solely responsible for the effect of same and for soil movements, or disturbance, which may take place, and for all damages to structures, construction, or other operation. Side slopes and sheeting shall be such as the Contractor may elect after due consideration of soil stability, conditions to be encountered, or codes.
   1. Prior to compacting imported soil material, having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.

B. Site Embankment Preparation:
   1. Remove all topsoil, vegetation, rubble to a depth of 6” minimum or as shown on the drawings.
      a. Stockpiling topsoil required for re-use on site as shown.
   2. Scarify/disc top twelve (12”) inches of exposed surface and compact.

3.02 PROOF ROLLING – NONE

3.03 FILLING AND BACKFILLING

A. Placing Fill Materials:
   1. Schedule filling to expedite construction progress and to maintain positive site drainage.
   2. Backfill in manner to prevent excessive pressure against work-in-place [walls and footings].
   3. Place fill and backfill material in uniform layers of thickness commensurate with the soil material and compacting equipment used maximum lift 12”. Compact in true planes at correct elevations.
   4. Placing and Compacting:
      a. Do not place aggregate base on frozen, soft, unstable or rutted subgrade, subbase, or aggregate base. Do not rut or distort the subbase material or aggregate base during spreading.
   5. Compaction of granular material in vicinity of walls shall be hand plate compactors.

B. Compaction:
   1. Compact soil material with equipment suitable for the soil material being compacted and the location of the work relative to other construction and capable of obtaining the required percentage maximum density throughout the entire layer of soil material.
   2. Prior to compacting imported soil material, having a well-defined moisture-density relationship, increase or reduce the moisture content of the soil material as determined by the applicable Proctor Test within limits of plus or minus 3 percentage points.
   3. Do not flood soil material in place.
   4. Suspend compaction operations when weather conditions or other unsatisfactory conditions make it impossible to obtain satisfactory results.

C. Fill and Percentage Maximum Density Requirements:
   1. Under Foundations: Fill or backfill under concrete foundations for building from surface to underside of foundation with Granular Material, place in 12 maximum layers, and compact to Modified Proctor Test 95% maximum density.
   2. Floor Slab-on-Ground: Fill under concrete floor-slab-on-ground within building walls from surface of subgrade or backfill, as applicable, to underside of concrete floor slab-on-ground with Granular Material, place in 12” maximum layers, and compact to Modified Proctor Test 95% maximum density.

3.04 GRADING

A. General: Grade and fill materials placed under this Section to provide a smooth surface within the specified tolerances, free of voids and soft spots, and compacted.

B. Areas within Building Walls: Shape surface of fill or backfill within building walls and slabs to line and grade plus-or-minus ½" of subgrade elevation indicated for underside of concrete floor slab-on-ground when tested within a 10-foot straight-edge applied both parallel to, and at right angles to the walls enclosed the area.

C. Areas Adjacent to Exterior of Structures: Hand grade areas adjacent to exterior building walls and other structures to drain away from the building or structure and to prevent ponding of water.

3.05 CLEANING

A. Make every effort to keep streets, roads and drives free from waste material resulting from earthwork operations. Clean such surfaces as required, or when directed, to eliminate any waste material deposited.

END OF SECTION

SITE EXTERIOR
PAVING AND SURFACE RESTORATION
Section 32-01-10

PART 1 - GENERAL

1.01 SUMMARY

A. This Section list general requirement for restoration of pavement and landscaping surfaces.
B. Related Requirements: Specific section specifications 32-01-nn through 32-99-nn.

1.02 SITE CONDITIONS

A. Environment: Seasonal/temperatures limit on Work activities are as follow.
   1. Paving: -Hot Mixed Asphalt (HMA): May 5 through November 15.
      -Portland Cement Concrete: Atmospheric Temperature: 45° F and rising.
   2. Plantings:-Seed and/or Sod: April 15 through October 10.
      -Trees: Confiers: March 1 through June 1.
      Deciduous: March 15 through May 15
      October 15 through non- frozen soil
B. Existing Conditions – R.O.W.:
   1. Conditions of sidewalk and driveways shall be noted in advance of excavation. Damage to such surface items shall be replaced at the Contractor's expense.
   2. Mailboxes, if removed during construction, shall be temporarily supported for mail delivery.
      a. At the completion of the Work, mailboxes shall be reset to locations specified by the postal service.
      b. Mailboxes, if damaged as a result of construction, shall be replaced as new.
   3. Landscape Features: Landscape items [boulders/rocks/signs] shall be relocated prior to excavation work. At completion of the Work, such items shall be repositioned to their original location.
   4. Drainage Structures: Catch basin, driveway culverts, ditches, beyond the excavation area, damaged by the Contractor shall be repaired, corrected and/or replaced.

PART 2 – PRODUCTS As specified in specific Specification Sections.

PART 3 – EXECUTION

3.01 PREPARATION

A. Surfaces damaged by and/or removed by the Contractor shall be further removed to the nearest existing transverse/longitudinal joint.
   1. Where the joint is more than five (5') feet from the damaged edge, the surface shall be sawcut in a straight line parallel to the existing transverse/longitudinal joint.

B. Restored Surfaces:
   1. Concrete sidewalks/driveways shall be replaced to the existing widths. Surfaces shall be "screeded" to match existing surfaces and "screeded" in such a manner to provided positive drainage.
      a. Sidewalks shall have a minimum thickness of six (6") inches at driveways and four (4") inches elsewhere.
      b. Driveways shall have a minimum thickness six (6") inches.
   2. Asphalt (HMA) surfaces shall be replaced as shown on the drawings. Surfaces shall edged/feathered to match existing surfaces and provide positive drainage.

3.02 INSTALLATION As specified for the respective Work/material/surface.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section discusses requirements for placement, maintenance and removal of temporary pavement materials.
   1. Snow plowing and ice removal will be performed by others: City DPW or Road Commission.
B. Related Requirements:
   1. Aggregate Base
   2. Temporary Pavement & Repair.

1.02 REFERENCES

A. Definitions:
   1. Cold Patch:
      a. Non-heated mixture of bituminous binder; aggregate, sand and modifiers that produce a product easy to handle and as temporary roadway surfacing.

1.03 DELIVERY STORAGE

A. Cold patching material shall be stored at the Contractor's staging area.

1.04 SITE CONDITION

A. Environmental:
   1. Winter Conditions: November through March.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Base:
   1. 21A or 22 gradation as noted on drawings.
   2. Specified for permanent pavement placement.
B. Cold Patch:
   1. Binder: Binder shall be liquid that can be stored for six months and remain workable at temperatures between 15 degrees Fahrenheit to 100 degrees Fahrenheit. The binder shall have such properties as to permit the placement of the mixture under damp conditions.
   2. Aggregate: Uniformly graded gravel, limestone, sand and/or fly ash 23A/26A.
   3. Modifier: #2 Fuel Oil and or Kerosene.

2.02 MIXES – TEMPORARY

A. HMA Hot-Mixed Asphalt:
   1. Available plant mixes.
   2. Mixture 3C, or 4B.
B. Cold Patch:
   1. Commercial or Plant Mixture: (by weight)
      a. Aggregate 90-95%
      b. Binder: less than 10%
      c. Modifier: 0-5%

PART 3 – EXECUTION

3.01 PREPARATION

A. Base:
   1. Base material shall be added to adjust for the final design pavement thickness less the proposed temporary pavement thickness of two (2") inch.
   2. Spread added aggregate uniformly and compact to provide a temporary surface.

3.02 INSTALLATION

A. Placement:
   1. Uniformly spread and compact the surface material to the dimension shown on the drawings.
B. Tolerance:
   1. After placing and shaping the variance between the surface and a 10-foot straight edge (any two contacts with the surface, shall not exceed ½" inch.

3.03 REMOVAL AND DISPOSAL

A. Removal:
   1. Remove temporary surface material and base as required for the final/pavement surface section.
      a. Final permanent surface depth shown on drawings.
B. Disposal:
   1. Disposal of excavated material (surface and base), remove from project site or use for excavated trench backfill.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes material specifications for items to be incorporated in the Work for the General Division Bases and Paving.
B. Related Requirements: Technical Specification 32-nn-nn

1.02 REFERENCES

A. Definitions:
1. Aggregates: Aggregates are natural aggregates originating geologically from stone quarries, gravel, or igneous/metamorphic rock deposits.
2. Granular Material: Granular materials for use as fill, trench backfill, and subbase shall consist of natural sand, gravel, crushed stone, and iron blast-furnace slag. Foundry sand or fly ash will not be permitted.
B. Reference Standards:
1. Standard Specification for Construction: "Michigan Department of Transportation" 2012 Standard Specifications for Construction Tables 902-1,902-2, 902-3,
2. Uniform Soil Classification System ASTM D2487.

1.03 INFORMATIONAL SUBMITTALS

A. Test Reports or Certification when required by specific specifications.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregates:
Aggregates may be Gravel, Stone or Slag meeting MDOT physical requirements and shall conform to the following class and gradations:

	Sieve analysis	Total Percent Passing								Loss by Washing (LBW)	
Mark	3 in.	2in	1.5in	1in	3/4in	1/2in	3/8in	#4	#8	#30	#100	Lbw
Coarse Aggregates;												
3x4	100	97-99	71-97	15-71	4-15	3-4	3-2	--	--	---	---	
34R	--	---	---	---	---	100	90-100	--	0- 5	---	---	3
21A	----	---	100	85-100	---	50-75	---	----	20-45	----	---	4-8
21AA (a)	----	---	100	85-100	---	50-75	---	----	20-45	----	---	4-8
22A	----	---	---	100	90-100	---	60-85	---	30-50	---	---	4-8
23A	---	----	----	100	---	---	60-85	---	25-60	---	---	9-16

(a) crushed material 95% minimum

B. Granular Material:
1. Class II; passing sieve: 3" through No. 100.

C. "FF"- Flowable Fill: A transit mixed blend of Sand, 2MS or 2NS; Portland Cement, type I; and fly ash, class C.

Mixture, by Volume..	60	1	20
By weight..	50	1	10

D. Geo Textiles:
1. Geotextile Separator for Foundation Bedding:
a. non woven fabric; puncture: 130 lbs.: burst 400psi;
b. propane 4553, Arrnco
2. Geotextile for Rip rap;
a. minimum 4.5 oz. per sq. yard weight;

b. contain non-toxic lampblack as an ultraviolet inhibitor;
c. conform to ASSHTO M-288
d. grab tensile strength: 270lbs.
e. burst strength: 400 psi
f. opening size: 0.21 mm

3. Geotextile Silt fence :
   a. produced product for use as a silt fence
   b. grab tensile strength; 100 psi;
   c. trapezoid strength; 45 lbs
   d. water flow rate; 30 gal/min/sq.ft.

E. Geo grids:
1. Presto Products; GW 30V, or
2. Tenstar BX 1100.

2.02 PRODUCT USES

Unless noted otherwise, on the drawings, materials shall be used as listed for specific items of Work below:

Item of Work/	Mark/aggregate type				
Specification	3x4	34R	21A	22A	23A
Edge drains;	…..	X			
Stabilize subgrade;	X				
Temporary Roadway;	X				
Roadway Base course:	…..	….	X		
Roadway Surface Course;	…..	….	….	X	X
Shoulders;	….	…..	…..	…..	X

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes requirements and material for the construction of Aggregate Base Courses, depths and widths shown on the drawings.
B. Related Requirements:
   1. Common Material Bases and Pavement 32-05-16.
   2. Asphalt Paving 32-12-20.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Submit names of Aggregate Supply source.
   2. Sample of proposed material and gradation analysis.

1.03 QUALITY ASSURANCES

A. Field Deliveries:
   1. Furnish a ticket with each load that states the project number, aggregate source, aggregate series, date, time, gross weight, tare weight, net weight to the nearest 100 pounds.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregate shall be 21A or 21AA (95% crushed) as noted on the drawings.

PART 3 – EXECUTION

3.01 PREPARATION

A. Subgrade:
   1. Scarify and reshape the subgrade to the cross slopes as shown on the drawings.
   2. Roller compact the subgrade to 95% of AASHTO T-180 (Modified Proctor).

3.02 INSTALLATION

A. Placing and Compacting:
   1. Provide aggregate with a uniform gradation and free from contamination when placed. Do not place aggregate base on frozen, soft, unstable or rutted subgrade, subbase, or aggregate base. Do not rut or distort the subbase material or aggregate base during spreading.
   2. Compact aggregate to not less than 98 percent of maximum unit weight at a moisture content not greater than optimum for aggregate base under hot mix asphalt pavement. Shape the finished surface and the layer thickness to the crown and grade within a tolerance of $\pm$1/2 inch.
B. Conditioning Aggregate Base:
   1. Shape the finished surface of the existing aggregate base course to the required grade and cross section, within a tolerance of $\pm$1/2 inch. Additional aggregate may be required to obtain the required grade or cross section. Where the existing surface is irregular or where additional material is required, mix the loose and compacted materials to a minimum depth of 2 inches and recompact.
C. Maintenance During Construction:
   1. Maintain the completed aggregate base course in an uncontaminated, smooth, compacted condition, substantially true to line, grade, and cross section until the next layer is placed.
   2. If the subgrade, subbase, or aggregate base is damaged due to the Contractor's operations or by traffic, restore to the specified condition at the Contractor's expense.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes requirements and material for the construction of Aggregate Surface Courses, depths, partial and full widths shown on the drawings.

B. Related Requirements:
   1. Common Material Bases and Pavement 32-05-16.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Submit names of Aggregate Supply source.
   2. Sample of proposed material and gradation analysis.

1.03 QUALITY ASSURANCES

A. Field Deliveries:
   1. Furnish a ticket with each load that states the project number, aggregate source, aggregate series, date, time, gross weight, tare weight, net weight to the nearest 100 pounds.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Aggregate shall be 21A or 21AA (95% crushed) as noted on the drawings.

PART 3 – EXECUTION

3.01 PREPARATION

A. Subgrade:
   1. Scarify and reshape the subgrade to the cross slopes as shown on the drawings.
   2. Roller compact the subgrade to 95% of AASHTO T-180 (Modified Proctor). [full width only]
   3. Trench/Partial Width:
      a. Trench crossing, perpendicular to roadway shall be plate compacted.
      b. Trench parallel to roadway:
         1) Cut/remove existing surface aggregate beyond the edge of trench straight and parallel with the roadway centerline.
         2) Compact trench backfill and exposed roadway subgrade with existing equipment and plate compactors.

B. Placing and Compacting:
   1. Provide aggregate with a uniform gradation and free from contamination when placed. Do not place aggregate base on frozen, soft, unstable or rutted subgrade, subbase, or aggregate base. Do not rut or distort the subbase material or aggregate base during spreading.
   2. Place aggregate in layers (six 6” inch) maximum, spread, level and compact. Place second layer of aggregate, level and grade to match existing roadway surfaces.
   3. Compact aggregate to not less than 98 percent of maximum unit weight at a moisture content. Shape the finished surface and the layer thickness to the crown and grade within a tolerance of $\pm$1/2 inch. [full width only]

C. Conditioning Proposed Roadway-Subgrade:
   1. Shape the finished surface of the existing roadway subgrade and trench backfill to the required grade and cross section, within a tolerance of $\pm$1/2 inch. Additional aggregate may be required to obtain the required

grade or cross section. Where the existing surface is irregular or where additional material is required, mix the loose and compacted materials to a minimum depth of 2 inches and recompact.

D. Maintenance During Construction:
   1. Maintain the completed aggregate base course in an uncontaminated, smooth, compacted condition, substantially true to line, grade, and cross section until the next layer is placed.
   2. If the subgrade, subbase, or aggregate base is damaged due to the Contractor's operations or by traffic, restore to the specified condition at the Contractor's expense.

E. Project Closeout:
   1. At project completion, prior to issuance of Substantial Completion, the portion of the constructed roadway shall be:
      a. Regraded;
      b. Aggregate added to re-establish plan roadway grades.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes basic materials, mixes and placement criteria for Hot Mixed Asphalt paving.

B. Related Requirements:

1. Aggregate Base Course 32-11-23.
2. Paving and Surface Restoration 32-01-10.
3. Common Materials for Bases and Paving 32-05-16.

1.02 REFERENCES

A. Abbreviations:

1. HMA – Hot Mixed Asphalt.
2. RAP – Reclaimed Asphalt Pavement.
3. MDOT – Michigan Department of Transportation.
4. RCOC – Road Commission of Oakland County.
5. Mixture Parameters:
   a. VMA – Voids in Mineral Aggregate.
   b. VFA -
   c. JMF – Job-Mix-Formula.
   d. GMB – Bulk Specific Gravity.
   e. GMM - Maximum Specific Gravity.

B. Reference Standards:

1. Standard Specification for Construction: "Michigan Department of Transportation 2003".

1.03 ACTION SUBMITTALS 01-33-00

A. Product Data:

1. Source of Materials: Submit source of bituminous paving materials proposed for the work giving the name and address of the supplier.
2. Job Mix Formula: Submit proposed job mix formula and the testing results for each bituminous mixture to the Engineer and RCOC one week (7 days) prior to paving.
3. Delivery Tickets: Submit one copy of each delivery ticket, indicating delivered weights for bituminous mixtures to Engineer Inspector.

1.04 CLOSEOUT SUBMITTAL

A. Density Testing Correlation: Submit one HMA in place core for density test correlation as described in Paragraph 3.03.E2.

B. Pay Weight Adjustments: When blast furnace slag or steel furnace is used in the production of HMA mixtures, the pay weight of the HMA mixture will be the product obtained by multiplying the actual tons of HMA mixture used by the factor of 150 divided by the maximum field density (in pounds per cubic foot) for the HMA mixture.

1.05 SITE CONDITIONS

A. Environmental Conditions:

1. Do not apply bituminous materials on wet surfaces, when weather is rainy or threatening rain, or when surface temperature is below 40°F.
2. Target placement temperatures per MDOT Section 502.03.E Table 502-1.

Surface Temp. of °F	Rate of Application Lb/Syd	
	120-200	200+
40-49	330	315
50-59	315	300
60-69	300	285
70-79	285	270

3. Allowable placement tolerance shall be +/- 20°F. All loads having temperature below 250°F or above

350°F at time of discharge from hauling unit will be rejected.

4. Grade Control: Establish and maintain the required lines and grades for each course during construction operations. Reestablish cross slopes as shown on the drawings.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Bituminous Materials: MDOT Standard Specifications, Section 904, and as follows:
   1. Bond Coat: Asphalt Emulsion SS1h.
   2. Asphalt binder usually PG 64-22 for leveling and top courses and PG 58-22 for base course unless polymer modified binder is necessary.

B. Aggregates: MDOT Standard Specifications

C. Recycled Asphalt (RAP): Recycled Asphalt shall "reclaimed asphalt pavement" free of "cold patch" and other deleterious materials.
   1. Processed RAP shall be a size that will be compatible with the specified HMA mixture.
   2. Binder adjustments may be made according to MDOT special provision 03SP501(G) "Recycled Hot Mix Asphalt Mixture".

2.02 MIXES

A. Composition of Hot Mixed Asphalt: MDOT Standard Specifications, Section 501.and Table 904 using aggregates specified in this Paragraph.

1. **Table 1: Mix Design Criteria and Volumetric Properties**

	Mixture No.				
	2C	3C	4C	13A	36A
Target Air Void, % (a)	3.00	4.00	4.00	3.0	4.00
VMA (min) (b)	11.00	13.00	14.00	14.00	15.00
VFA	65-78	65-78	65-78	65-78	65-78
Fines to Binder Ratio (max) (c)	1.2	1.2	1.2	1.2	1.2
Flow (0.01 inch)	8-16	8-16	8-16	8-16	8-16
Stability (min), lbs	1200	1200	1200	900	900

a. Lower target air voids by 1.00% if used in a separate shoulder paving operation. Air void targets to 3.00% for lower traffic volume roadways when designing 13A and 36A and mixtures for local agency use.
b. VMA calculated using Gsb of the combined aggregates.
c. Ratio of the weight of aggregate passing the No. 200 sieve to total asphalt binder content by weight; including fines and binder contributed by RAP.

2. **Table 2: Aggregate Properties**

	Mixture No.				
	2C	3C	4C	13A	36A
	Percent Passing indicated Sieve or Property Limit				
1 ½ inch	100				
1 inch	91-100	100			
¾ inch	90 max.	91-100	100	100	
½ inch	78 max.	90 max.	91-100	75-95	100
5/8 inch	70 max.	77 max.	90 max.	60-90	92-100
No. 4	52 max.	57 max.	67 max.	45-80	65-90
No. 8	15-40	15-45	15-52	30-65	55-75
No. 16	30 max.	33 max.	37 max.	20-50	
No. 30	22 max.	25 max.	27 max.	15-40	25-45
No. 50	17 max.	19 max.	20 max.	10-25	
No. 100	15 max.	15 max.	15 max.	5-15	
No. 200	3-6	3-6	3-6	3-6	3-10

Crushed (min), % (MTM 117)	90	90	90	25	60
Soft Particle (max), % (a)	12.0	12.0	4.0	8.0	8.0
Angularity Index (min) (b)	4.0	4.0	40	2.5	3.0
L.A. Abrasion (max), % loss (c)	40	40		40	40
Sand Ratio (max) (d)	-	-	-	50	50

a. The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 8.0 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone particles must not exceed 12.0 percent for aggregates used in base and leveling courses.
b. The fine aggregate angularity of blended aggregates, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by the virgin material. NAA fine aggregate angularity must be reported for information only and must include the fine material contributed by RAP if present in the mixture.
c. Los Angeles abrasion maximum loss must be met for the composite mixture, however, each individual aggreagate must be less than 50.
d. Sand ratio for 13A and 36A no more than 50% of the material passing the No. 4 sieve is allowed to pass the No. 30 Sieve.

B. Mixes shall be designated as Mixture Number.
   1. HMA mixes for leveling courses and wearing courses shall be as shown on the drawings.

2.03 QUALITY CONTROL

A. Material acceptance testing: Acceptance sampling and testing will be performed by the Road Commission using the sampling method and testing options selected by the Engineer. Each day of production, the Road Commission will determine the number of samples to be taken for each mix type. Acceptance testing will be performed at minimum frequency of one per 1000 tons. Quality Control measures to insure job control are the responsibility of the Contractor.

B. HMA Tolerances: Tolerance limits for HMA job-mix-formula shall be as set forth in the RCOC Special Provision – "Acceptance of HMA mixture on Local Agency Project" 3 page, revised 08/07.
   1. The Contract unit price for crushed particle content above or below that specified and noted in Table 1, Range 2 shall be reduced 25 percent.
   2. The Contract unit price for HMA outside of tolerance noted in Table 2 (AirVoid, VMA and GMM) will be reduced 50 percent.

C. Pavement density will be measured for acceptance with a Nuclear Density Gauge using the Bulk Specific Gravity (GMB) from the job-mix-formula (JMF) for the density control target.

PART 3 – EXECUTION

3.01 PREPARATION

A. Bond Coating:
   1. Treat bituminous or portland cement concrete, or both, base course surfaces with bond coat applied at a uniform rate of 0.10 gallon per sq. yd. and in accordance with MDOT Standard Specifications, Section 502.03.D.
   2. Where paving existing bituminous surface, remove all loose materials from paving surface, then treat surface with bond coat. Bond coat application shall be:
      a. 0.10 gal/yd^2 on ex. pavement.
      b. 0.05 gal/yd^2 between HMA course.

3.02 INSTALLATION

A. General:
   1. Equipment, transportation of mixtures, placing hot mixed asphalt mixture, and rolling shall be as specified in MDOT Standard Specifications, Section 502 "Hot-Mixed Asphalt Construction Practices".
   2. Application temperature for bituminous materials shall be as specified in Paragraph 1.05.A.2.

3. Application Schedule: Hot mixed asphalt shall be placed at the application rates as noted on the plan section details.
4. Cleaning Pavement: Before the bond coat is applied, the HMA surface shall be cleaned as directed by the Engineer with a mechanical sweeper that does not throw or emit dust.

B. Hot Mixed Asphalt Pavement: Mix designations shall be as shown on the drawings.
1. Over Aggregate Base Course:
   a. Construct hot mixed asphalt leveling course over aggregate base in one lift having compacted nominal thickness as specified on the drawings. Note: If noted on the drawings 2C base course shall be placed in two (2) lifts.
   b. Treat hot mixed asphalt leveling course surface with bond coat applied at a uniform rate of 0.05 gallon per sq. yd.
   c. Construct hot mixed asphalt wearing course over bond coat treated leveling course in one lift having compacted nominal thickness of 1" or greater as required to provide the total bituminous pavement thickness as specified on the drawings.
2. Over Other Bases: Construct hot mixed asphalt wearing course over bond coat treated bituminous base course or Portland cement concrete base course or existing bituminous paving, as applicable, in one lift having compacted nominal thickness as specified on the drawings.

C. Placing and Spreading:
1. On aggregate base course or bond treated leveling course, as applicable, place hot mixed asphalt mixture using self-propelled spreading and finishing equipment, at a uniform rate avoiding intermittent operation.
2. After spreading and before compaction, adjust any surface inequalities by hand, adding or removing bituminous mixture as required.
3. Coat portion of concrete curbs, catch basins and the like against hot mixed asphalt is placed with bond coat (asphalt emulsion). Protect all other surfaces.
4. Adjust irregularities in outside edges before rolling. Edge each course straight following initial rolling.
5. "Set up" longitudinal joints at proper height above adjacent construction to receive maximum compaction, coat with bond coat (asphalt emulsion), hand rake, and broom to provide dense, smooth connection.
6. Don't hand rake edges. Proper height should be adjusted on paver.
7. Compact from hot side with roller hanging 6" over unsupported edge or cold joint.

D. Compaction:
1. Roll each course as soon after spreading as the mixture will bear the roller without undue displacement or hair cracking. Continue until all roller marks are eliminated and no further compaction is possible.
2. Roll longitudinally; from edges toward center, overlapping on successive trips with alternate trips terminated at least 3 feet from preceding stops.
3. Compact areas inaccessible to the roller with hot hand tampers.
4. Remove defective bituminous mixture or mixture contaminated with foreign material, replace with fresh bituminous mixture, and compact to the density of the surrounding area.

E. Finish: Surfaces of each finished course shall be smooth, and constructed true to line, grade and cross-section to the tolerance tests under Article 3.03.

3.03 FIELD QUALITY CONTROL

A. Visual Test: Surface of finished hot mixed asphalt paving shall be free from depressions, ridges, cracks, soft areas, roller marks, and other irregularities.

B. Smoothness Test:
1. The surface of finished hot mixed asphalt paving shall not show any deviation in excess of 3/16" when tested with a 10-foot straightedge applied both parallel with and at right angles to the centerline of the paved area.
2. The average allowable deviation shall be not more than 1/8"
3. Measurements shall be made at random locations as directed by the Engineer and on the basis of 3 tests for each 500 square yards of completed hot mixed asphalt paving.

C. Cross-Section Test:
1. The cross-section of finished hot mixed asphalt paving shall not show any deviation in excess of ¼" when tested with a crown template centered on and at right angles to the centerline of the crown.
2. Measurements shall be made as specified under Paragraph 3.03.B.3.

D. Thickness Control:
   1. The average thickness of each hot mixed asphalt course shall be within ¼" of that shown on the drawings.
   2. Measurements shall be made at random locations as directed by the Engineer on the basis of one measurement for each 500 square yards of completed hot mixed asphalt.

E. Density Compaction:
   1. The required in-place Density for the HMA mixture shall be based on the (JMF) Air Voids. A minimum of 97% in-place Density of the (GMB) for 3% Air Void mixes, and a minimum of 96% in-place Density for 4% Air Void mixes. The Contractor shall be responsible for establishing a rolling pattern that will achieve the required in-place Density.
   2. At least one core per Job-Mix-Formula shall be obtained after final rolling is completed. The asphalt cores shall be tested to correlate the actual density with Nuclear Density Gauge(s) according to the MDOT Procedure for Determining Pavement Density as described in MTM 315. The engineer will mark the core location with a two-inch diameter paint dot which represents the center of the core.
      a. The Contractor shall drill a 6-inch core sample at the core location. The Contractor shall notify the Engineer sufficiently in advance of coring to ensure that RCOC has a representative to witness the coring operation and take immediate possession of the cores.
      b. The minimum thickness of the core shall comply with MTM 315. If it is insufficient, or if the core is damaged, the Engineer shall document the problem and select another location for coring if necessary.

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes materials and requirement for permanent parking lot striping, surface use, and directional symbols.

1.02 REFERENCES

A. Standard:
   1. US Federal Specifications.
   2. Michigan Department of Transportation.

1.03 ACTION SUBMITTALS

A. Submit product data sheets for Engineer reviews two weeks prior to proposed application.

1.04 QUALITY ASSURANCE

A. Provide a "mark-up" of a typical parking lot application with legends/symbols for Engineer/Inspector review.

1.05 SITE CONDITIONS

A. Environmental:
   1. Marking materials shall be placed dry pavement and during the months of May 1 and October 1 inclusive.
   2. Water borne paints shall be applied when the pavement surface temperature is 50°F or higher. All lines washed or damaged by rain shall be reapplied.
   3. Alkyd or Acrylic Traffic paints shall be applied after the HMA surface has cured for 14 days. Pavement surface temperature shall be 35°F or higher.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Water borne paints shall be "TAPCO" or "Shermin-Williams" conforming to US Federal specifications TT-P-1952B and D.
B. Acrylic/Alkyd paints shall be "TAPCO" or "Shermin-Williams Promer".
C. Paint colors shall be as noted below:
   1. "Yellow" for all warning applications.
   2. "Blue" for road guidance and evacuation routes.
   3. "Fluorescent yellow-green for pedestrian, bicycle warning.

PART 3 – EXECUTION

3.01 PREPARATION

A. Examination:
   1. Inspect existing pavement surfaces for conditions and defects that will adversely affect quality of work, and which cannot be put into an acceptable condition through normal preparatory work as specified.
   2. [Verify that new asphalt is complete, has been accepted by Owner/Architect/Engineer, and cured a minimum of fourteen (14) days if possible.]

B. Preparation:
1. Thoroughly clean surfaces free of dirt, sand, gravel, oil and other foreign matter.
2. Remove curing compound on new concrete surfaces.
3. Protect adjacent curbs, walks, fences, and other items from receiving paint.
4. Provide “mark-up”.

3.02 INSTALLATION

A. Provide qualified technician to supervise equipment and application of marking. Layout markings using guide lines, templates and forms. Stencils and templates shall be professionally made to industry standards. “Free hand” painting of arrows, symbols, or wording shall not be allowed.

B. Application:
1. Apply marking paint at a rate of one (1) gallon per three to four hundred (300-400) lineal feet of four (4) inch wide stripes. (or to mfg. specification).
2. Apply stripes straight and even in accordance with schedules.
3. Apply stripes and other markings in widths and colors detailed in schedule.

C. Tolerances:
1. Apply 4 and 8 inch wide lines with a tolerance of +1/4 inch. Apply solid lines with no gaps or spaces. Edge lines must be solid lines. Apply a double line as either two solid lines or one solid line and one broken line.
2. Apply sharp and well defined markings, free of uneven edges, overspray, or other readily visible defects determined by the Engineer. Pavement marking lines must be straight or of uniform curvature. Remove pavement markings that are not placed as specified and re-apply in the correct locations. Re-apply pavement markings damaged by traffic that were not protected and remove tracked lines. All costs associated with this corrective action will be borne by the Contractor.

D. Protection:
1. Barricade marked areas during installation and until the marking paint is dried and ready for traffic.
2. Maintain traffic so vehicles do not have to cross the wet markings. Place suitable devices such as traffic cones to protect the wet markings.

END OF SECTION

PART 1 – GENERAL *[Engineer – include section – note watering 2 years after project completion/closeout]*

1.01 SUMMARY

A. This section includes items of work for special watering of plants placed on-site.

1.02 ADMINISTRATION

A. Scheduling: Water and cultivate during each of the following periods:
   1. From June 1 to June 15,
   2. From June 23 to July 7,
   3. From July 15 to July 29,
   4. From August 4 to August 18, and
   5. From September 5 to September 19.

PART 2 – PRODUCTS

2.01 MIXES

A. Watering Fertilizers:
   1. Water soluble, nitrogen-enriched fertilizer containing 8.3 pounds of nitrogen per 1,000 gallons of water.

PART 3 – EXECUTION

3.01 PREPARATION

Watering and Cultivating: In addition to the watering-in required at the time of planting, water, cultivate, and remove grass and weeds around each plant at least 5 times during each of the two growing seasons of the establishment period. The Engineer may add or subtract watering as conditions warrant. Notify the Engineer at least 3 days before each watering.

A. During each watering and cultivation, remove grass and weeds within the planting area. Cut grass to 3 inches high, 12 inches beyond the outside perimeter. Inspect landscaping and remove insect infestations or disease damage to the plants and prune dead wood.
B. Equipment Probe:
   1. Water with a probe that meets the following requirements:
      a. Is long enough to extend to the depth of the root ball;
      b. Has a diameter no greater than 1 inch;
      c. Has a closed pointed end with holes in the lower 4 inches; and
      d. Is equipped with a control valve for regulating water pressure and volume.

3.02 INSTALLATION

A. Water Quantity: Use the following volumes of water for the specified plants:
   1. For shade trees, 35 gallons per watering;
   2. For intermediate plants and evergreen trees, 20 gallons; and
   3. For shrubs, 5 gallons.
B. Installation:
   1. During the first and second watering of the second growing season, use a nitrogen-enriched solution. Apply fertilizer before July 7.
   2. At the first watering of the second growing season, remove and dispose of the guying material, wrapping material, identification tags, and inspection tags. At the final watering, replenish the mulch around the plants to a depth of 5 inches to 6 inches.

C. Closeout:
1. Contractor must water for 2 years after project completion and closeout.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the work consisting of labor, material, and equipment for landscape-topsoil on a prepared subgrade.
B. Related Requirements:
   1. Site Excavating and Grading 31-22-16.

1.02 REFERENCES

A. Definitions:
   1. Friable: Friable is defined as a soil which is easily crumbled or pulverized.

1.03 INFORMATION SUBMITTALS

A. Test Reports:
   1. Submit certification of material testing for every 500 cubic yards of topsoil delivered to the site.

1.04 QUALITY ASSURANCE

A. Testing:
   1. Topsoil material shall be tested for conformity every 800 cyds of material and or every 5000 Syd as placed.

1.05 SITE CONDITIONS

A. Environmental:
   1. Do not prepare or place soils that are dry, excessively wet, or frozen.
   2. Do not prepare soils when adverse conditions exist that may preclude obtaining desired results.
B. Existing Conditions:
   1. Grade Control: Establish and maintain the required lines and grades for lawn areas during construction operations.

2.01 MATERIALS

A. Topsoil:
   1. Topsoil shall be fertile, friable, and representative of productive soil, capable of sustaining vigorous plant growth, and shall be free of clay lumps, sub-soil, weeds, roots, seeds, and other foreign debris (larger than 1”).
   2. Material shall meet the following criteria:
      a. Acidity range shall be between pH 5.5 and 7.5.
      b. Organic content shall be not less than 5% and not greater than 30%.
      c. Clay content shall range between 5% and 25%.
   3. Topsoil shall be <u>un-screened farm field topsoil</u> and is subject to inspection by Engineer upon arrival to project site or screened Topsoil
   4. Topsoil shall be screened topsoil.

3.01 PREPARATION

A. Preparation of earth bed.
   1. Eliminate uneven areas and low spots.
   2. The earth bed subgrade upon which the topsoil is to be placed shall be at the required grade and properly

trimmed. Just prior to placing topsoil all earth beds, which includes areas previously mulched or rye seeded for temporary erosion control, shall be harrowed into a friable condition with a disk, a spring tooth drag or a spike tooth drag to a minimum depth of 3" (three inches). The harrowing shall be done so that all soil impressions left by all equipment are horizontal across the face of the slope. All topsoil that has been placed on conditioned earth bed shall be incorporated into the upper of the earth bed. Topsoil shall not be worked when in a wet condition.

B. Physical Structures:
   1. Flag/mark all drainage structures, and irrigation devices.
   2. Place filter cloth or sediment control material over all drainage inlets.

3.02 PLACEMENT

A. Place topsoil in areas as designated on the Contract Drawings. Thickness shall be as called for on the Contract Drawings. Place topsoil during dry weather. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
   1. Manually spread topsoil close to existing plant life, buildings, and other above grade appurtenances to prevent damage.

B. After spreading, any large clods and lumps shall be pulverized and all stones and rocks over 2" (two inches) in diameter, roots, litter, and all foreign matter shall be raked up and disposed of by the Contractor off site.

C. Tolerances:
   1. Top of Topsoil: Plus or minus ½ inch or as called for on the Plans.

3.03 CLEANING

A. After topsoil has been placed to final grades, remove and dispose of grade sketches, surface trash, and other matter detrimental to future maintenance operations.

B. Excess Items:
   1. Immediately clean up spillages of soil materials.
   2. Remove and dispose of excess materials upon completion of work.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes materials and listings for the applications of seeds for lawns and grasses.
B. Related Requirements:
   1. Topsoil 32-91-19
   2. Paving and Surface Restoration 32-01-10.
   3. Common Materials for Bases and Paving 32-05-16.

1.02 REFERENCES

A. Definitions:
   1. Friable: Friable is defined as a soil which is easily crumbled or pulverized.
   2. Friable Condition: A soil in a "friable condition" is defined as a surface which is in a crumbled, pulverized, worked-up, loosened, or cultivated state; free of lumps and clods detrimental to seeding and sodding operations.
B. Reference Standards:
   1. MDOT – Michigan Department of Transportation standard specification.

1.03 ACTION SUBMITTALS

A. Product Data:
   1. Grass Seed Test Reports: Submit two copies of report covering grass seed purity and germination tests.

1.04 SITE CONDITIONS

A. Environmental:
   1. Do not perform seeding work when adverse conditions exist, including high wind that may preclude obtaining desired results.
   2. Plant grass seed from the time soil is workable between April 1st and October 15th.
B. Reconditioning Existing Lawns: Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of construction vehicles, and existing lawn areas as indicated.
   1. Provide fertilizer and seed as specified for new lawns and as required to provide a satisfactorily reconditioned lawn. Provide topsoil as required to fill low areas and meet new finish grades.
   2. Cultivate bare and compacted areas thoroughly.
   3. Remove diseased or unsatisfactory lawn areas. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, stone, gravel, and other construction materials. Where substantial but thin lawn remains, rake, aerate if compacted, and cultivate soil; fertilize and seed.
   4. Water newly seeded areas. Maintain adequate soil moisture until new grass is established.

2.01 MATERIALS

A. Hand Seeding:
   1. Fertilizer shall be 5N-20P-20K.
   2. Mulch shall be straw, hay, or any locally available mulch of acceptable quality as approved by the Engineer. Free of matured seed, noxious weeds or other materials which would be detrimental to lawn development or to future lawn maintenance.
B. Hydro-Seeding:
   1. Fertilizer shall be 12N-20P-12K

2. Mulch shall be wood cellulose fiber mulch: Degradable wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydro-mulching.

C. Mulch Blanket shall be:
   1 Photo degradable, polyethylene mesh:
      a. single net- Western Excelsior SR1'
      b. double net – Western Excelsior SR2
   2. Bio degradable, suite, North American 3150 BN
   3. Mulch blanket anchors shall be:
      a. 6" wood staples'
      b. 6" steel staples,
      c. 8' anchor staples

2.02 MIX

A. Seed Mixture shall be MDOT designations as follows:
   1. "THM": Kentucky Blue Grass, Perrenial Ryegrass, Hard Fescue, Creeping Red Fescue.
   2. "TUF": Kentucky Blue Grass, Perrenial Ryegrass, Hard Fescue, Creeping Red Fescue, Fults Salt Grass.

3.01 – EXECUTION

A. Preparation:
   1. Preparation of Earth Bed: The earth bed upon which the topsoil is to be placed shall be at the required grade and properly trimmed. Prior to placing the topsoil, the earth bed shall be in a friable condition to a minimum depth of 3 inches. Earth beds shall be harrowed with a disk, a spring tooth drag or a spike tooth drag just prior to placing topsoil. The harrowing shall be done horizontally across the face of the slope. The tops and bottoms of all slopes shall be rounded to blend into the natural ground or adjacent slopes by vertical curves.
   2. Fertilizing: For areas to be seeded, chemical fertilizer shall be evenly applied on the prepared topsoil surface at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients, in equal proportions of Nitrogen, Phosphoric Acid and Potash, or as directed by the Engineer. Fertilizer spread by drill or broadcast methods will be placed or worked into the soil to a depth of one to two inches. Fertilizer and fertilizer-seed slurries spread hydraulically shall be incorporated into the soil.

3.02 SEEDING

A. Sowing:
   1. Sow the seed following or in conjunction with fertilizing while the seed bed is in a friable condition. Just before seeding, harrow the topsoil and/or compost 3 inches deep or more. Harrow with a disk, a spring tooth drag, a spike tooth drag, or other equipment designed to prepare the soil to a friable condition and meeting the approval of the Engineer. Harrow horizontally across the face of the slope. Sow seed before applying mulch. Sow or resow the seed mixture, providing uniform coverage, at the rate of 220 lbs/acre. Sow with either mechanical drills, hydroseeders, or by broadcasting. Broadcast in areas to be resown or in areas that are unaccessible to a drill or hydrosseder.
   2. Setting the Seed: Lightly compact or rake areas sown by hydroseed or broadcast methods to incorporate the seed into the uppermost ½ inch of the topsoil surface. Immediately after setting the seed, mulch

B. Hydro-Seeding/Mulch: Use a hydromulcher (sprayer) and apply mixture(s) at the following rates. Mix in accordance with manufacturer's recommendations.
   1. Use for erosion prone slopes greater than 4:1 or drainage swales.
   2. Apply mixture A hydroseed slurry to indicated steep erosion prone areas.
      a. Seed: 250 lbs./acre.
      b. Type A fertilizer: 200 lbs./acre.

c. Tackifier: 60 gals./acre.
d. Wood cellulose fiber mulch: 2,000 lbs./acre.

3.03 MULCH BLANKETS

A. Mulch Blankets: Place mulch blankets within one day after seeding. Overlap blanket side edges two inches. Shingle lap blanket ends 6 inches. Place staples or pegs along all joint edges and along blanket centerlines at a maximum spacing of two feet. However, in waterways single lap blankets with an overlap of 12 inches on the downslope edge. When blankets are installed from the top of the slope, do not allow them to free fall down the slope. Use net anchors recommended by the manufacturer. Steel wire staples or pins are not acceptable. Place and anchor blankets according to the manufacturer's directions if those requirements are greater than these minimum requirements.

B. Watering:
1. Water seeded areas, at 3.5 gallons per square yard when required. Continue watering regularly so that seed/seedings do not dry out.
2. Water mulch blanket slopes two (2) intervals when directed by the Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes listing materials for the construction of distribution water mains.
B. Related Requirements:
   1. Distribution Hydrants - 33-12-16.
   2. Commissioning Water Distribution Systems - 33-08-10.

1.02 REFERENCES

A. Standards:
   1. ANSI – American National Standards Institute.
   2. AWWA – American Water Works Association.
B. Reference Standards:
   1. MDOT Michigan Department of Transportation – "Standard Specifications for Construction".
   2. ASTM American Society of Testing Material – "Specific Volume/Article".
   3. NSF 61 – ANSI/NSF Standard 61 – "Drinking Water System Components".
   4. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances

1.03 ACTION SUBMITTAL

A. Product Data: Submit data sheets for all water main materials.

PART 2 - PRODUCTS

2.01 MATERIALS

All pipe and fittings shall meet ANSI/NSF Standard 61 and shall have their certification information stamped on the exterior pipe wall along with the pipe class material type and date of manufacturer clearly marked on each piece.

A. Ductile Iron Pipe:
   1. Ductile Iron Pipe shall conform to AWWA C151/ANSI Specifications A21.50 and A21.51.
      a. Pipe wall class shall be: Class 54 for watermain pipe 6" through 16".
      b. Ductile iron pipe shall be double lined with bituminous seal coated cement mortar with tapered ends. The cement mortar lining and seal coat shall conform to the requirements of the AWWA C104/ANSI Specification A21.4.
      c. Joints shall be "push-on" type to conform to the latest revision of the ANSI Specifications A20.10 and A21.11.
   2. Ductile Iron Fittings:
      a. The ductile iron fittings shall meet all the requirements of ANSI Specification A21.10, 125 psi for pressure piping.
      b. Mechanical joints shall conform to ANSI Specification A21.11. (hydrant tees only)
      c. Bolts shall be "Cor-Blue".
B. Restrained Joints (when noted in the drawings):
   1. Mechanical Joint Restraint (RJ) shall be ductile iron for use with mechanical joints conforming to ANSI Specifications A21.11 and A21.53. Device shall have rated working pressure of 250 psi. Supplier: EBBA Iron Inc. "Megalug Series 1100.
   2. Locking gaskets (RJ) shall be Lock-tyte.
C. Polyvinyl chloride Pipe:
   1. PVC pipe shall conform to AWWA C900.
      a. Pipe wall class shall be class 200, DR-14.
      b. Joints shall be "pushon" type.
D. Couplings for "cut-in" assemblies shall be:
   1. Cascade waterworks style CDC; or

2. Romac Industries style 501.

E. HDPE Pipe.

2.02 MIXES

A. Pipe Bedding: Bedding material shall be:
1. Granular Class 2; or
2. Stone.

B. Masonry Materials:
1. Concrete block shall be solid pre-cast conforming to ASTM C 139.
2. Concrete brick shall conform to ASTM C-55, Grade S-11.
3. Concrete shall be:
a. Transit mixed concrete 3000 psi 5 sk
b. Field mixed:
1) Portland cement ASTM C-150 I; Masonry sand, 2MS; and Stone Aggregate ¾" to 1" max.
2) Proportions 1:2:4.
4. Piling may be steel I beam or 8"/6" Ductile Iron Pipe.

PART 3 - EXECUTION

3.01 PREPARATION

A. Minimum cover over mains shall be 6 feet or as required by the local municipality including crossings through ditch sections. When mains parallel ditches, they shall have 6 feet of cover below the ditch shoulder, to insure cover for house service.

B. The location of the piping as shown on the Plans, has been determined to avoid, insofar as possible, interference with structures or fixtures aboveground and other underground mains, services, utilities, or structures.
1. Whenever it is necessary to deflect pipe from a straight line, either in the horizontal or vertical plans, to avoid obstructions or where long radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing and shall be approved by the Engineer. In no case shall deflection of joints exceed the manufacturer's recommended maximum deflection.

C. Thrust Block: Thrust blocks for watermains shall be sized as follows: Area in square feet of concrete thrusting against undisturbed earth shall be computed by dividing the total thrust by the safe bearing load of the soil. Bearing Area is determined: Thrust [table a] / soil bearing[table b] = sq. ft. of bearing area

Thrust [table a]

a. Area in square feet of concrete thrusting against undisturbed earth shall be

Main Size	Tee-Dead-End	90° Bend	45° Bend	22-1/2° Bend
6"	4,250 lbs.	6,000 lbs.	3,250 lbs.	1,660 lbs.
8"	7,540	10,670	5,770	2,940
12"	16,970	23,990	12,980	6,620
16"	30,160	42,650	23,090	11,770
20"	47,120	66,650	36,070	18,390
24"	67,860	96,000	51,940	26,480
36"	152,680	215,920	116,860	59,580

b. Safe bearing load (pounds per sq. ft.) psf.

Soil Type	lbs. per sq. ft.
Muck, Peat, etc.	0
Soft Clay	1000
Sand	2000
Sand and Gravel	3000
Sand and Gravel cemented with clay	4000

Hard Compact Clay	5000

3.02 INSTALLATION

A. Placement:
1. Proper and suitable tools and appliances for the safe and careful handling, conveying and laying of the pipe shall be used. Care shall be taken to prevent the coating of cast iron pipe from being damaged. Pipe, valves, hydrants and fittings strung along the route shall be placed in such a manner that they will not be submerged or collect water.
2. All pipes shall be laid true to the required lines and grades. All trenches when pipe laying is in progress shall be kept dry; and all pipes and specials shall be uniformly supported on a properly trimmed excavation with holes at each joint to receive bells.

B. Construction:
1. All excavation shall conform to specifications, backfill and bedding installation shall comply with AWWA C600. Pipes shall be laid on a compacted sand bedding 4 inches thick, and around and above the main to a height of 12 inches with sand. Sand shall be compacted in 6-inch lifts and to 95% density. The subgrade upon which the pipe is placed shall consist of material suitable for supporting the pipe without excessive settlement or stress development.
2. All cutting of the pipe shall be done in a neat workmanlike manner with the least amount of waste and without damage to existing or new lines. A fine tooth saw, tubing or pipe cutter, or similar tool shall be used to cut the pipe. Cut must be square and ragged edges removed with a cutting tool and/or file.
3. Thrust blocks shall be placed at all 22-1/2, 45, 90° bends, tees, and dead ends; crosses as required.
   a. Thrust block size shall be determined:
      1) As shown on the drawings and;
      2) Providing a soil contract area determined as noted in Article 3.01C1, above.
   b. In muck or peat, all thrust shall be resisted by pilings driven to solid foundations or by removal of muck or peat and replacement with ballast of sufficient stability to resist thrusts. In all cases, thrust block size and method of thrusting must be approved by the Engineer before the thrust block is poured.
4. At the termination of pipe laying any open ends of pipelines shall be closed off by a suitable cover until laying operations are resumed.

3.03 START-UP

A. Distribution Water piping and appurtenances shall be pressure tested per the current version of AWWA C600 and chlorinated as specified in “Commissioning Water Distribution Systems Section – 33-07-10”.

B. Prior to connection to existing system, new watermain must be disinfected according to AWWA C651 and bacteriologically sampled in accordance with R325.11110 of the administrative rules promulgated under Michigan Safe Drinking Water Act, 1976 PA 399, as amended.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes materials and procedure for construction site subdrainage system.
B. Related Requirements:
   1. Common Earthwork Materials 31-05-10.
   2. Landscape Restoration 33-nn-nn.
   3. Submittals

1.02 REFERENCES

A. Definitions:
   1. Inline drains: Prefabricated fixtures of attachment to pipe fittings.
   2. Drain basin: Prefabricated cylinder with pipe openings.
   3. HDPE – High Density Polyethelene. Pipe
B. Reference Standard:
   1. AASHTO: American Association of State Highway Transportation Offices.
   2. ASTM: American Society of Testing Materials.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Submit detail shop drawings for all “Drain Basins”
B. Product Data:
   1. Submit data sheets for all pipe fittings and fixtures.

PART 2 -

2.01 MATERIALS

A. Pipe Fittings:
   1. Corrugated pipe and fittings shall be HDPE pipe conforming to AASTHO M-252.
      a. Perforated Corrugated Pipe (PCP) shall be single wall 3-hole perforation Type CP AASHTO.
      b. Smooth Flow Corrugated Pipe (SFCP) have a smooth invert providing a n=0.012, conforming to AASHTO – Type S .
   2. Drain Fixtures: Drain Fixtures shall meet Mechanical Properties of ASTM D3034.
      a. Inline Drain shall be a pipe and bell spigot to connect to the corrugated pipe el or tee.
      b. Drain basins shall have a round bottom flange, pipe bell spigots for collector pipe and surface grating.
B. Geotextile
   1. Sack for the perforated pipe (PCP) shall meet properties specified in AASHTO M 288 Class A.
C. Gratings: Casting material shall conform to ASTM A536 gr 10-50-05 and ASTM A-48 Class 305 for gates 12” and larger.
   1. Grates for 8” and 10” shall be “standard style”.
   2. Grates 12” and larger shall be “pedestrian – H-10 rated” unless noted otherwise on the drawings.
   3. Grates shall be “locking” type.

2.02 MIXES

A. Granular Material:

1. 2G or 34R Pipe Bedding.
2. 2G Pipe Encapsulating.
3. Class II Trench Backfill and Drain Basin Backfill.

B. Trench Backfill – Excavated Material.

PART 3 -

3.01 PREPARATION

A. Field Measurement:
1. Verify depths of Drain Basin for fabricated units versus plan/staked profiles.

3.02 INSTALLATION

A. Pipe shall be placed to the grades shown on the drawings.
1. SFCP pipe shall be placed on a stone bedding and covered with granular material as shown.
2. Perforated Pipe (PCP) shall be covered with geotextile fabric (sock) placed on stone bedding and encapsulated with stone as shown.
3. Bedding and stone and granular material shall be placed in twelve (12”) lifts/layers.

B. Drain Fixtures:
1. Inline drains shall be set in vertical pipe risers and gratings leveled.
   a. Vertical pipe risers shall be plumb with granular material compacted in place.
2. Drain basins shall be set on stone bedding aligned for pipe lateral connection.
   a. Drain basins shall have extensive fan proper depth.
   b. Drain basins shall be plumb with granular material compacted in place.

C. Grates:
1. Grates shall be set level and locked in position.
2. Grates shall be covered with filter cloth at time of installation.
3. Place filter cloth on all basin grates.

D. Trench backfill shall be placed in 12>18” lifts and roller compacted.

3.03 SYSTEM CLEAN-UP

A. Remove filter cloth from grates and flush the complete system clean.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section include listing of materials and procedures for the construction of piping and accessories for gas supply to electric generators and building devices.

1.02 REFERENCES

A. References:
1. ASTM – American Society of Testing Materials.
2. ASME – American Society of Mechanical Engineers.
3. ANSI – American National Standard Institute.

B. Reference Standard:
1. Internal Fuel Gas Code.

1.03 ADMINISTRATIVE REQUIREMENT

A. Coordination: Contractor shall schedule and coordinate the construction activities with the Natural Gas Supplier utility.
1. Gas Operating Pressure, after the Utility Company Meter shall not be more than 2.0 psig.

PART 2 – PRODUCTS

2.01 PIPING, TUBES, AND FITTINGS

Products shall be sized for the minimum operating pressures listed below.
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Service Meter Minimum Operating Pressure: 5 psig

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
3. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and polyethylene.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1; include flame-retardant polyethylene coating, copper-alloy threaded ends, and striker plates.

C. Polyethylene Pipe: ASTM D 2513, SDR 11.
1. Polyethylene Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. Polyethylene Transition Fittings: Factory-fabricated fittings with Polyethylene pipe complying with ASTM D2513, SDR 11 and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

D. Appurtenances:
1. Appliance Flexible Connectors:
a. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Strainers: ASTM A 126, Class B, cast-iron body, Y-pattern, full size of connecting piping. CWP rating of 125 psig. Include 40-mesh startup strainer, and perforated stainless-steel basket.

3. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
4. Service Meters: Comply with gas company requirements.
5. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by mils thick, solid yellow color, continuously inscribed with a description of the utility.

2.02 VALVES

A. General Requirements for Metallic Manual Gas Shutoff Valves: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
B. Polyethylene Ball Valves: Comply with ASME B16.40.
C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
   1. Body: Bronze, complying with ASTM B 584.
   2. Ball: Chrome-plated brass.
   3. Stem: Bronze; blowout proof.
   4. Seats: Reinforced TFE; blowout proof.
   5. Packing: Separate packnut with adjustable stem packing threaded ends.
   6. CWP Rating: 600 psig.
   7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Body: Bronze, complying with ASTM B 584.
   2. Ball: Chrome-plated bronze.
   3. Stem: Bronze; blowout proof.
   4. Seats: Reinforced TFE; blowout proof.
   5. Packing: Threaded body packnut design with adjustable stem packing.
   6. CWP Rating: 600 psig.
   7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
E. Bronze Plug Valves:
   1. Body: Bronze, complying with ASTM B 584.
   2. Plug: Bronze.
   3. Operator: Square head or lug type with tamperproof feature where indicated.
   4. Pressure Class: 125 psig.
   5. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   6. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
   1. Body: Cast iron, complying with ASTM A 126, Class B.
   2. Plug: Bronze or nickel-plated cast iron.
   3. Seat: Coated with thermoplastic.
   4. Stern Seal: Compatible with natural gas.
   5. Operator: Square head or lug type with tamperproof feature where indicated.
   6. Pressure Class: 125 psig.
   7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   8. Service: Suitable for natural gas service with "WOG" indicated on valve body.
G. Valve Boxes: Cast iron, two section, with base to fit over valve and barrel minimum 5 inches in diameter.
H. Electrically Operated, Automatic Gas Valves: ANSI Z21.21, for operation by appliance automatic shutoff device.

I. Gas-Pressure Regulators: Single stage, steel jacketed, and corrosion resistant. Include atmospheric vent and elevation compensator.
   1. Gas-Pressure Regulators: Single stage, steel jacketed, and corrosion resistant. Include atmospheric vent and elevation compensator.
   2. Line Pressure Regulators: ANSI Z21.80; 5-psig-maximum inlet pressure.
   3. Appliance Pressure Regulators: ANSI Z21.18; 2-psig-maximum inlet pressure.
   4. Gas-Pressure Regulator Vents: Factory-or field-installed, stainless-steel screen in opening when not connected to vent piping.

PART 3 – EXECUTION

3.01 PREPARATION

A. Comply with International Fuel Gas Code for installation and purging of natural-gas piping.

3.02 INSTALLATION

A. Outdoor Exterior Location:
   1. Install underground, PE, natural-gas piping according to ASTM D 2774.
   2. Install shutoff valve, downstream from gas meter, outside building at gas service entrance.
   3. Install service meters to comply with gas company requirements.
   4. Install pressure gage downstream from each service regulator.
   5. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight.

B. Interior Building Location:
   1. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps. Piping shall be free of sags and bends and install fittings for changes in direction and branch connections.
   2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
   3. Piping Installed Under Buildings: Install piping under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with a weatherproof vent cap.
   4. Install service meters to comply with gas company requirements.
   5. Install gas stops for shutoff to appliances with low-pressure gas supply.
   6. Install escutcheons at penetrations of interior walls, ceilings, and floors.

3.03 PIPE & VALVE CONSTRUCTION

A. Joints:
   1. Threaded Joints: Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Welded Joints: Construct joints according to AWS D10.12M/D10.12
   3. Joints in Steel Piping with Protective Coating: Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", Pipe and Tube" Chapter.
   5. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
   6. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions conforming to SAE J513. Tighten finger tight then using wrench. Do not overtighten.

7. Joints In Copper Tubing with Protective Coating: Apply joint cover kits over to cover, seal, and protect joints.
8. Polyethylene Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

B. Valve Installation:
1. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
2. Install underground valves with valve boxes.
3. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
4. Install anode for metallic valves in underground Polyethylene piping.

3.04 SYSTEM START-UP

A. Inspect, test, and purge piping according to International Fuel Gas Code and authorities having jurisdiction.
B. Field Test:
1. Operate the Gas Supply system at bulkhead to determine adequate gas supply.
a. On-site Electric Generator.
b. Building appliance and heaters.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This section is comprised of standards of construction and materials for the Division and those divisions of these Specifications under which process and service equipment is provided and installed. Construction methods and materials for special systems, not described in this section, are specified under the detailed section to which they apply.
   1. These specifications and the accompanying drawings are intended to comprise the furnishing and installing of all materials, equipment and supplies as specified herein and required for the satisfactory completion of all work including the installation of Owner furnished equipment.
   2. Drawings show arrangement, general design and extent to the systems and are diagrammatic except where in certain cases they are detailed giving exact locations and arrangement. The drawings are not intended to be scaled for rough-in dimensions. Where shop drawings are required for this purpose or field measurements are needed for the installation, they shall be prepared by the installing contractor.
   3. All apparatus and equipment furnished and installed by the Contractor must be of such dimensions and design as to be adapted to the arrangement of the installation and to fit within the limits of the space available for them.

1.02 ADMINISTRATIVE REQUIREMENT

A. Coordination:
   1. Submit to and obtain from trades concerned, copies of shop drawings and catalog data of work which connects with or affects his work. Make arrangements with other trades as required to properly correlate installation into the overall project.
   2. Each Subcontractor/Supplier shall be responsible for establishing his elevations and routing of process piping and control supply/devices as they relate to the work with other trades.
   3. Coordinate location and arrangement of equipment, piping, ductwork, etc. In case of interferences between various items, or if simplified construction procedures are possible by relocation or changes in arrangement, then changes may be made if approved by Engineer in writing.

B. Scheduling: Before proceeding with installation of piping, ductwork or other system, contractor shall inspect the contract documents and determine that the location of the work does not interfere with other work. In case of interference, the owner shall be notified in writing. The Owner shall then determine the resolution of the interference and shall so inform the Contractor. The Owner's decision shall be binding.

1.03

1.04 ACTION SUBMITTALS

A. Action and Informational Submittals: Submittal as noted the specific sections and in the manner specified 01-33-00.

1.05 CLOSE-OUT SUBMITTAL

A. As specified in specific division section.
B. Record Drawings:
   1. The Contractor shall be responsible to maintain a complete and accurate set of marked up drawings during construction. Mark ups shall record any and all changes or deviations from the contract drawings.

   2. Record drawings shall be delivered to the Engineer after completion of the work as a permanent record of the installation as actually constructed.

1.06 DELIVERY STORAGE

A. The Contractor shall coordinate delivery of equipment with his construction program so that an undue amount of storage space is not required. Space for contractor's use will be designated by the Owner.
   1. The Contractor shall exercise care in the protection of materials and equipment furnished and/or installed under this contract while they are in storage at the site and during and after installation prior to final acceptance.
   2. All materials and equipment shall be handled in a manner to avoid damage or breakage and delay in the completion of the work. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Owner, all items damaged or broken as a result of his operation.

B. Equipment:
   1. All machined surfaces of the equipment subject to corrosion shall be protected by coating with grease I immediately after finishing.
   2. All flanges shall be protected prior to installation by means of wooden flanges bolted in place.
   3. Equipment and materials stored outdoors shall be blocked up at least six inches above the ground.
   4. Openings in valves and pipe shall be kept covered to prevent dirt, rubbish or water from entering. Machined surfaces such as flange faces, pipe threads, machined weld ends of pipe, and fittings shall be protected from corrosion by proper Owner approved compounds.
   5. All parts of the equipment shall be carefully crated to facilitate shipping and handling. The crates shall be constructed to completely protect the equipment and shall be sufficiently strong to permit lifting and skidding without requiring additional bracing or reinforcement.
   6. Whenever the shop coat of protective paint is damaged, spot coating shall be made immediately to prevent rusting.
   7. All materials shall be so delivered, stored, and handled as to prevent the inclusion of foreign materials and/or damage by water, breakage or other causes. Packaged materials shall be delivered in original unopened containers and shall be stored until ready for use. Packages or materials showing evidence of damage or contamination, regardless of cause, will be rejected. All materials that have been stored shall be subject to retest and shall meet the requirements of these Specifications at the time they are used in the work and at the time of final acceptance of the work.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.01 PREPARATION

A. Site Examination:
   1. Verify site conditions under which this work must be conducted prior to commencing. Contractor shall be held to have examined the premises and satisfied himself and is to be fully conversant with all conditions. No claim for additional compensation due to his failure to make this evaluation is allowed.
   2. Examine all spaces, surfaces, and areas to receive the work. Do not proceed until corrections, if any required, have been made.
   3. Verify dimensions, elevations, grades and obtain all measurements required for proper execution of the work.
   4. Verify points of connections to utilities prior to start of construction and report any inconsistency before commencing work.

B. Cutting and Repairing:
   1. All cutting and repairing of existing and completed work, which is required for the installation of the Work shall be done by the respective contractors for the various trades involved.

2. The Contractor shall provide openings in the floors, walls, etc., as required for the installation of the piping and equipment.
3. Cutting shall be avoided whenever possible, but any cutting required in the new construction shall be performed by the Contractor under the direction of the Engineer.
4. Where piping, ductwork, conduit, etc. must pass through walls, floors or other building components, the Contractor shall provide reinforcement or support adjacent to the opening to compensate for the removal of any support material.

3.02 INSTALLATION

A. Lines and Grades:
1. Work shall be constructed in conformity with lines and grades as indicated on drawings. Benchmarks shall be used from which lines and grades required for installation of mechanical work may be set.
2. The Contractor shall lay out his work and be responsible for lines, elevations and measurements required for the installation of his work.

B. Interior Work:
1. Pipe lines above ground shall be run parallel within the structure(s) unless otherwise shown or noted on the drawings. Vertical lines shall be kept as close to the walls as possible. Pipelines shall be run so as not to interfere with ducts, conduits or apparatus, as may be indicated on the drawings.
2. All horizontal lines shall pitch to low points to provide for complete drainage of each system. Pitch, unless otherwise shown on the drawings shall be not less than 1 inch in 40 feet against direction of flow.

C. Clearances:
1. Mechanical equipment shall be installed so that maintenance and replacement can be performed without the removal of other equipment.
2. Clearance around pumps, coils, fans, air conditioners, etc. shall be provided for operation, maintenance, replacement, repair and removal.
3. Piping connections to equipment shall be made with valves, unions, or Victaulic fittings to permit their repair or removal without causing damage to piping or equipment.
4. Prior to shop fabrication of ductwork, piping, conduit, etc., make field measurements and review shop drawings to check for clearances and interferences.
5. Due to the scale of drawings, all required fittings, offsets, elevation changes, and routing are not shown. The intent of these drawings and specifications is that these shall be installed without additional cost.
6. Maintain proper headroom and pitch of lines.

3.02 SYSTEM STARTUP

A. Testing:
1. The testing requirements for the respective piping systems shall include all those of the applicable governing codes, such as state, local, and insurance, and those hereinafter specified. All code required inspection certificates shall be furnished by the Contractor, as required. Test pressures are specified for each piping system.
2. All tests shall be made before piping is painted, covered or concealed. The Contractor shall furnish all pumps, compressors, gauges and other necessary testing equipment and make all necessary connections, make provisions to cap all normally open ended pipes, isolate any equipment or devices requiring isolation and provide all labor to perform these tests.
3. All piping systems shall be tested hydrostatically at 50 psi greater than maximum operating pressure but not less than 50 psig for two hours, unless otherwise noted.
4. The Contractor shall provide all materials, equipment and labor necessary to perform these tests.
5. No loss of water will be allowed on exposed piping under test. A loss of water equivalent to 1/5 gallon per inch of diameter per 1000 feet of line per hour of test will be permitted for buried lines under a test pressure of 50 psi or greater.

B. Adjusting:

1. When the work included in these specifications is complete, and at such time as directed by the Owner, the Contractor shall adjust all parts of the systems, advising the Owner when this has been done and work is ready for final tests.

2. If it becomes necessary for temporary use of the systems by the Contractor, before all parts are complete, the Contractor shall adjust all parts as far as possible in order to make said temporary use as effective as possible.
3. If such temporary use is for the Owner's benefit and cleaning or repairing of damage is necessary due to the Owner's actions, such cleaning and repair cost shall be paid by the Owner based on a prior negotiated price.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes a listing of pipe and fittings materials.
B. Related Requirements:
   1. Process Division 40-nn-nn.
   2. Trenching Excavation and Backfill 31-23-33.

1.02 REFERENCES

A. Abbreviation:
   1. Pipe:
      a. DIP – Ductile Iron Pipe.
      b. STL – Steel Pipe.
      c. GS – Galvanized Steel Pipe.
      d. PVC – Polyvinyl Chloride Pipe.
      e. Copper – Copper Pipe.
   2. Fittings:
      a. BF. –blind flange
      b. BFC- bolted flexible coupling
      c. EJ- expansion joint
      d. FJ- flange joint
      e. GC- grooved joint
      f. MJ- mechanical joint

1.03 ACTION SUBMITTAL

A. Product Data:
   1. Cuts/data sheets shall be submitted for review.

1.04 QUALITY ASSURANCE

A. Products listed shall have markings noting the respective standard Agency/specification notation.

1.05 DELIVERY STORAGE

A. Pipe and Fittings shall be stored to protect same from the elements. Plastic products shall be stored in accordance with suppliers recommendations.

PART 2 – PRODUCTS

2.01 FLANGED DUCTILE-IRON PIPE/FITTINGS/COUPLINGS

A. Flanged Ductile-Iron Pipe:
   1. ANSI/AWWA C115 ductile-iron pipe with factory installed ductile-iron flanges, not less than 250 psi rated working pressure, flanges plain faced and drilled to match ANSI B16.1 Class 125 flanges, and with standard thickness ANSI/AWWA C104 double cement lining. Per ANSI 21.4.
      a. Pipe wall class shall be: Class 54 pipe: 6” through 12” diameter.
         Class 56 pipe: 16” through 30” diameter
   2. With plain ends where required for compression coupling and prepared as follows:

a. Outside ends of pipe shall be free from indentations, projections or roll marks for a distance of 8" from the ends to permit the pipe to make a watertight joint with the coupling.
b. For pipe 3" to 12" O.D., the outside diameter of the pipe shall vary no more than plus-or-minus 0.06" from the nominal outside diameter for a distance of 8" from the end of the pipe and shall permit the passing for the distance of 8" of a ring gauge which has a bore 0.01" larger than the nominal outside diameter of the pipe.

3. With grooved ends where required for mechanical couplings, prepared in accordance with the recommendations of the coupling manufacturer, as approved.

B. Pipe Fittings:
1. Bends, tees, crosses, reducers: ANSI/AWWA C110 ductile-iron, flanged fittings, rated minimum 250 psi water working pressure, plain faced and drilled to match ANSI B16.1 Class 125 flanges.
2. Side outlet fittings; laterals and other fittings not covered under Paragraph 2.01B.1: ANSI B16.1 cast-iron flanged fittings, and rated 175 water working pressure.
3. Bolting Materials: ASTM A307, Grade B., zinc plated, stainless steel in 'wetwells' .
4. Gaskets: 1/8" thick, synthetic rubber, material ANSI/AWWA C111/21.11 . unless noted otherwise. Gaskets may be either ring or full-faced style for pipe12"inch and smaller Pipe 14" and larger shall be 'ring' style.
5. Cement lining same as that of ductile-iron pipes to which connected.

C. Compression Couplings: BFC
1. Coupling shall be gasketed, sleeve type, of diameter to properly fit the pipe, designed for joining plain-end pipe, and consist of:
a. One steel middle ring, ¼" in thickness and length as required to sit conditions of installation.
b. Two steel followers.
c. Two rubber-compounded wedge section gaskets.
d. Sufficient track-head steel bolts with steel nuts to properly compress the gaskets.
2. Manufacturer: Dresser Industries, Inc. "Style 38", Rockwell International Corp. "Product 411" or approved substitute.

D. Flanged Adapter/Compression of Couplings: BFC
1. Adapters shall be flanged/compression type designed for joining plain-end pipe to flanged valves and fittings, and consist of:
a. Made of ASTM A126, Class B, cast-rion.
b. Flanged-end designed to mate with ANSI B16.1 Class 125 flange and furnished with bolts and nuts.
c. Compression-end complete with follower, rubber-compounded wedge section gasket, and sufficient track-head steel bolts with steel nuts to properly compress the gasket.
d. Factory-applied corrosion-resistant coating.
2. Manufacturer: Dresser Industries, Inc. "Style 127", Rockwell International Corp. "Product 912" or approved substitute.

E. Mechanical Couplings and Fittings
1. Couplings shall be designed to mechanically engage and lock the grooved pipe ends in a positive couple and to allow for some degree of angular deflection and contraction and expansion, and consist of:
a. Two or more housing clamps fabricated of ASTM A536, Grade 65-42-12, cast ductile iron.
b. Single Flush shaped sealing gasket made of ASTM D2000 Grade No. 3BA615A14 B13 synthetic rubber.
c. ASTM A183 oval neck track head bolts nuts.
d. Fittings conform to ANSI/21.10/AWWA C 110 for centre-to-end dimensions and wall thickness.
e. Flange adapters shall be ASTM A536 ductile iron, flat faced Class 125. Victauliuc Style 341.
2. Manufacturer: Victaulic Co. of American "Style 31", or approved substitute.

2.02 BLACK STEEL PIPE/MALLEABLE IRON FITTINGS

A. Pipe: ASTM A53, black steel pipe, standard weight, threaded and coupled.
B. Pipe Fittings:
   1. Ells, Tees, Reducers, Caps and Couplings:
      a. 3" and under, ANSI B16.3, 150-lb. Class, black malleable iron screwed fittings.
      b. Over 3", ANSI B16.1, 125-lb. Class, black cast-iron flanged fittings.
   2. Plugs and Bushings: ANSI B16.14, black malleable iron.
   3. Unions:
      a. 3" and under, ANSI B16.3, 150-lb. Class, black malleable iron, and brass seated unless otherwise specified.
      b. Over 3", companion flanges.
   4. Flanges: ANSI B16.1, 125-lb. Class, black cast-iron, flat face, threaded type.
C. Jointing Materials:
   1. Joint Compound: Ribbon type, unless otherwise specified.
   2. Bolting Materials: ASTM A307, Grade B.
   3. Gaskets: 1/16" thick, ASTM D1330 Grade II sheet rubber, full face, unless otherwise specified.

2.03 SEAMLESS STEEL PIPE/WELDING FITTINGS

A. Pipe: ASTM A53, Type S, Grade A, black seamless carbon steel pipe, Schedule 40, plain ends beveled.
B. Pipe Fittings:
   1. Ells, Tees, Reducers, Caps and Couplings:
      a. 3" and under, ANSI B16.11, 3000-lb. Class, ASTM A234 Marking WPB or equivalent, forged steel welding fittings.
      b. Over 3", ANSI B16.9, Schedule 40, ASTM A234 Marking WPA, carbon steel buttwelding fittings.
   2. Unions: Companion flanges.
   3. Flanges: ANSI B16.5, 150-lb. Class, forged steel welding type.
C. Jointing Materials:
   1. Welding Filler Metal: ANSI B31.1.
   2. Bolting Materials: ASTM A354, Grade BC, bolts, and ASTM A194, Grade 2, nuts.
   3. Gaskets: Made of metal having minimum 1000°F melting temperature, unless otherwise specified.

2.04 SEAMLESS STEEL PIPE/GROOVED MECHANICAL FITTINGS

A. Pipe: ASTM A53, Type S, Grade A, black seamless carbon steel pipe, schedule 40, roll or cut grooved ends.

B. Fittings: Victaulic standard grooved end fittings, shall be :
   1. ductile iron housings conforming to ASTM A536, forged or;
   2. Fabricated carbon steel conforming to ASTM A53;
   3. with factory grooved ends designed to accept Victaulic standard couplings.
C. Victaulic standard couplings, 2" through 12", shall consist of two ASTM A 536 ductile iron housings, pressure responsive, synthetic rubber gasket [grade to suit the intended service], secured together with plated steel bolts and nuts.
   1. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolts pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9.
      a. 2" through 6" Victaulic Style 107 QuickVic rigid coupling with grade EHP gasket for maximum operating. temperature of 250 deg F.
      b. 8" through 12" Victaulic Style 07 "Zero-Flex" standard rigid joint.
   2. Flexible Type; Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment locations. Three [3] couplings, for each connector shall be placed in close proximity to the source of vibration, Victaulic Style 75 or 77.

D. Victaulic AGS couplings, 14 through 24", shall consist of two ASTM A536 ductile iron castings with a wide key profile, lead-in chamfer and flat bolt pads for metal-to-metal contact. Gasket shall be wide-width, pressure responsive, synthetic rubber [*grade to suit the intended use*] and plated nuts.
   1. Rigid Type: Provides a rigid joint that corresponds with support spacings as defined by ASME B31.1 and B31.9. Victaulic Style W07.
   2. Flexible Type; v Allows for linear and angular movement, vibration attenuation and stress relief. Victaulic Style W77.

E. Victaulic Flange Adapters, 2" through 24";
   1. 2" through 12"; ASTM A536 ductile iron, flat faced, Class 125 and 150, Victaulic Style 741.
   2. 2" through 12"; ASTM A536 ductile iron, flat faced, Class 300, Victaulic Style 743
   3. 14" through 24"; ASTM A536 ductile iron, flat faced, Class 125 and 150, Victaulic Style W741

2.05 GALVANIZED STEEL PIPE/MALLEABLE IRON FITTINGS

A. Pipe: ASTM A120, galvanized steel pipe, standard weight, threaded and coupled.
B. Pipe Fittings:
   1. Ells, Tees, Reducers, Caps and Couplings:
      a. 3" and under, ANSI B16.3, 150-lb. Class, galvanized malleable iron threaded fittings.
      b. Over 3", ANSI B16.1, 125-lb. Class, galvanized cast-iron flanged fittings.
   2. Plugs and Bushings: ANSI B16.14, galvanized malleable iron.
   3. Unions:
      a. 3" and under, ANSI B16.3, 150-lb. Class, galvanized malleable iron, and brass seated unless otherwise specified.
      b. Over 3", companion flanges.
   4. Flanges: ANSI B16.1, 125-lb. Class, galvanized cast-iron, flat face, threaded type.
C. Jointing Materials:
   1. Joint Compound: Ribbon type.
   2. Bolting Materials: ASTM A307, Grade B, galvanized.
   3. Gaskets: 1/16" thick, ASTM D1330 Grade II sheet rubber, full face, unless otherwise specified.

2.06 COPPER WATER TUBE/SOLDER FITTINGS

A. Tube:
   1. ASTM B88, Type L (medium wall thickness), drawn temper, unless otherwise specified.
   2. Where underground or embedded in building construction, ASTM B88, Type K (heavy wall thickness) annealed temper.
B. Fittings:
   1. Ells, Reducers, Plugs, Caps and Couplings: ANSI B16.22.
   2. Unions: Cast brass, 125-lb. SWP, with solder joint ends and brass ground joint.
   3. Solder Metal: ASTM B32, Alloy Grade 95TA.

2.07 PVC PLASTIC PRESSURE PIPE SOCKET-TYPE FITTINGS

A. Pipe: ASTM D1785 PVC plastic pipe, schedule 40, minimum water pressure rating at 23°C of 150 psi.
B. Fittings: ASTM D2466 PVC plastic pipe socket-type fittings, schedule 40.
C. PVC Solvent Cement: ASTM D2564.

2.08 PVC PLASTIC PRESSURE PIPE/THREADED FITTINGS

A. Pipe: ASTM D1785 PVC plastic pipe, schedule 80, minimum water pressure rating at 23°C of 150 psi.
B. Fittings: ASTM D2464 PVC plastic pipe threaded fittings, schedule 80.

PART 3 – EXECUTION

3.01 PIPE JOINTS

A. General: Make pipe joints carefully and neatly in such manner that all joints are watertight and gas-tight under pressure required for the particular service.

B. Flanged Joints:
   1. Clean flange face with solvent-soaked rags to remove rust-preventative grease.
   2. Clean dirt from gasket and coat gasket with graphic and oil or other recommended lubricant. Insert treated gasket.
   3. Tighten flange bolts so that gasket is uniformly compressed and sealed.
   4. Do not distort flanges.
   5. Leave flange bolts with ends projecting 1/8" to 3/8" beyond face of nut after tightening.

C. Compression Coupling Joints:
   1. Cut ends of pipe square.
   2. Remove all burrs on inside and outside of pipe.
   3. Clean joint contact surfaces with steel wool before assembly.
   4. Install compression couplings in accordance with manufacturer's printed directions.

D. Mechanical Coupling Joints: Install in accordance with coupling manufacturer's installation recommendations.
   1. All grooved couplings, fittings, valves and specialties' shall be supplied by a single manufacturer, and Grooving tools shall be supplied by the same manufacturer as the grooved components.
   2. The gasket style and elastormeric material grade shall be certified as suitable for the intended service as specified, Gaskets shall be supplied by Victaulic.
   3. `Grooved ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for gasket sealing.

E. Threaded Joints:
   1. Threads: ANSI B2.1, NPT.
   2. Cut threads full and clean with sharp dies.
   3. Ream ends of pipe after threading and before assembly to remove burrs.
   4. Ream ends of pipe after threading and before assembly to remove burrs.
   5. Prior to making-up joint, clean male and female threads with wire brush.
   6. Make-up joint with joint compound or thread tape on male thread only.

F. Welded Joints:
   1. Make in accordance with ANSI B31.1 except made butt welding preparation dimensions for pipe ¾" and less in wall thickness in accordance with ANSI B16.25.
   2. For pipe 4" and smaller, perform welding by either gas welding (oxy-acetylene) process or by manual metallic arc process.
   3. For pipe over 4", perform welding by manual metallic arc process.
   4. Do not make direct welded connections to valves and other components which are intended to be removable, and at equipment connections.
   5. Welding Fittings:
      a. Use long radius elbows at changes in direction of piping.
      b. Use factory-made welding fittings; mitering of pipe or use of field fabricated welding will not be permitted.

G. Solder Joints:
   1. Thoroughly clean outside surfaces of copper water tube ends and inner surfaces of solder joint fittings before assembly.
   2. Apply non-corrosive flux and soldering metal in accordance with manufacturer's directions.
   3. Remove bonnets on all valves and cool body with damp asbestos cloth while soldering.

H. PVC Solvent Cement Joints:

1. Cutting Pipe:
   a. Cut pipe square with the axis, using a fine-tooth band saw and a miter box, or a fine-tooth power saw with a suitable guide.
   b. Remove all burrs on inside and outside of pipe with a knife, file or abrasive paper.
2. Joint Preparation:
   a. Chamfer or deburr pipe, or both, approximately as illustrated in Figure 6 of ASTM D2855.
   b. Surfaces to be jointed shall be clean and free from moisture before application of the primer or cement. Clean joint contact surfaces with chemical cleaners or mechanical cleaners in accordance with ASTM D2855 or PVC pipe manufacturer's instruction as approved. Clean surfaces with dry cloth to remove foreign matter.
3. Test fit pipe joint by measuring and marking the socket depth of the fitting on the outside of the pipe, taking care not to scratch or damage pipe surface, to ascertain when the pipe will be bottomed, pipe should enter the dry fitting at least 1/3 of socket depth.
4. Application of Primer and Cement:
   a. The surface temperature of mating surfaces shall not exceed 110°F. at the time of assembly. In direct sunlight or in ambient temperatures above 100°F., prepare surface as specified in ASTM D2855.

3.02 PIPING INSTALLATION

A. Pipe Layout:
   1. Where not concealed by other construction, give special attention to appearance of completed installation.
   2. Make provision for expansion and contraction during normal operation.
   3. Do not obstruct openings or passage ways.
   4. Run exposed piping in straight lines, plumb, parallel to building lines, unless otherwise indicated on the Drawings, and as close to walls and ceilings as is consistent with good workmanship.
   5. Locate groups of pipes parallel to each other. Space them at a distance to permit application of insulation, if any, and to permit access to servicing valves.

B. Cutting:
   a. Cut pipe from measurements taken at the site, not the Drawings.
   b. When necessary to cut pipe, do cutting with approved tools and cut pipe ends square and regular.
   c. Perform cutting of ductile-iron pipe in manner to avoid damage to lining and coating.

C. Inspection:
   d. Inspect pipe and fittings for soundness before installing in place.
   e. All damaged pipe and fittings will be rejected.

D. Offsetting: Offset work of this Section as directed by the Engineer to allow other trades to install their work, to avoid interferences with other piping and electrical conduit, to conceal the pipes more easily, or to allow for greater headroom under the pipes.

E. Concealed Piping:
   1. Install piping to be concealed by other construction at such time so as not to cause delay in the work of other Sections and to allow ample time for tests and approvals.
   2. Obtain approval of the Engineer before covering concealed piping.

F. Protection:
   1. Protect open pipe ends whenever work is suspended during construction.
   2. To prevent foreign bodies entering and lodging inside pipe, install temporary cast-iron or malleable iron caps or other method of protection as approved by the Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section lists requirements and devices/assemblies for the support (hangers and supports) for process piping and equipment.
B. Related Requirements:
   1. Common Work for Process Piping and Equipment 40-05-nn.
   2. Detailed Division Specific 40-nn & 43-nn.

1.02 REFERENCES

A. Reference Standards:
   1. Manufacturers Standardization Society of Valve and Fittings Industry (MSS):
      a. ANSI/MSS SP-58 Standard Practice for Pipe Hangers and Supports – Materials and Design.
      b. ANSI/MSS SP-58 Standard Practice for Pipe Hangers and Supports – Selection and Application.

1.03 ACTION SUBMITTALS

A. Shop Drawings:
   1. Submit support details if devices are different than that specified.
B. Product Data:
   1. Submit proposed hanger assemblies.

1.04 SITE CONDITIONS

A. Environmental:
   1. Material standards shall be as specified in ANSI/MSS SP-58 for ambient systems C (60° to 119°F) classification of piping systems.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Hanger Rods and Attachments:
   1. Hanger Rods: Grinnel “Fig. 140” or equal, carbon steel, threaded and length as required to suit conditions of installation.
   2. Turnbuckles: MSS SP-69 Type 13 or Type 15; such as Grinnel “Fig. 230” or “Fig. 114”.
   3. Swing Eyes: MSS SP-69 Type 16 or Type 17; such as Grinnel “Fig. 110R” or “Fig. 290”.
   4. Clevises: MSS SP-69 Type 14; such as Grinnel “Fig. 299”.
      a. Hanger rod diameter shall be as follows for the respective pipe diameter.
         3/8” dia: 3/4 to 2”; 1/2” dia: 2-1/2” to 3-1/2”; 5/8” dia: 4” to 3”;
         3/4” dia: 6”; 7/8” dia: 8” to 12”.
B. Brackets:
   1. “Unistrut” used for brackets and/or to support piping shall be Series P1000, galvanized, as manufactured by the Unistrut Products Co., Super Strut A-1200, Power Strut PS-200, or equal.
C. Horizontal Pipe Attachments:
   1. Pipe Clamps for Copper Water Tube: ANSI/MSS SP-58 Type 9; such as Grinnel “Fig. C7-99.
   2. Pipe Clamps for Plastic Pipe: ANSI/MSS SP-58 Type 9; such as Grinnel “Fig. 97”.
   3. Pipe Clamps for Steel Pipe: ANSI/MSS SP-58 Type 3; such as Grinnel “Fig. 295”.

D. Vertical Pipe Attachments:
   1. Riser Clamps for Copper Water Tube: ANSI/MSS SP-58 Type 8; such as Grinnel “Fig. CT-121”.
   2. Riser Clamps for Plastic Pipe and Steel Pipe: ANSI/MSS SP-58 Type 8; such Tube Straps: Grinnel “Fig. 9124”.
   3. Tube Straps: Grinnel “Fig. 9124”.

E. Pedestals
   1. Steel pipe shall be 3 inch dia. ASTM A-53 Sch 40 black seamless pipe.
      a. Bare plates: ASTM A-36
   2. Concrete shall be: 5.5 sk (3500 psi), 3.5 N

F. Inserts and Anchor Bolts:
   1. Inserts shall be continuous slotted inserts approximately 1-5/8” wide, 1-3/8” deep by length as required, roll formed not less than 12 gage steel into slotted “U” conformation for 5/8 in. bolt size unless otherwise indicated, with anchors spaced on not more than 6 in. centers, plates and bolts and nuts as required by conditions, shall be provided. Slotted inserts shall be Gateway Erectors, Inc., Type “G”, Hohman and Barnard Type CH05, or equal.
   2. Pedestals to be secured to floor slabs or concrete bases shall be fastened down with approved cast in place anchors.
   3. Drilled expansive anchor bolts are permissible provided that electric rotary drill are used, and that the specific hammers have been approved for the purpose by the Owner. Anchor bolts shall be Wejit, Parabolts, Kwikbolt, or equal. All bolts shall be stainless steel coated with anti-seize compound prior to assembly.

PART 3 – EXECUTION

3.01 PREPARATION

A. Field Measurements:
   1. Locate hangers, supports, and accessories to support pipelines, valves, and additional concentrated loads.
   2. Locate hangers, supports and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

B. Field Measure:
   1. Obtain vertical dimensions for pedestal support (pipe/concrete) for process piping.

3.02 INSTALLATION

A. Hanger and Support Installation:

Pipe Hanger and Support Installation: Comply with ANSI/MSS SP-58 . Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

   1. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
      a. Install concrete inserts before concrete is placed; fasten inserts to forms.
      b. Install reinforcing bars through openings at top of inserts.
   2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
   3. Install hangers and supports to allow controlled thermal and selemic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

4. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

B. Equipment/Pipe Pedestals:

Pedestals shall be constructed where indicated on the drawings and/or where process piping cannot be hung/suspended from the building frame/structure.

1. Concrete Pedestals (pipe support) shall be used for process piping using 9 inch to four feet 4'-0" s above the floor.
2. Pipe Pedestals (pipe support post) shall be used at all other locations.

3.03 ADJUSTING

A. Hangers:
1. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
2. Adjust hangers and supports to bring pipelines to proper elevations.

B. Pedestals:
1. Place grout under supports for equipment and make smooth bearing surface.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Valves for yard piping, process piping, and general building mechanical.
B. Pressure sustaining valves.

1.02 RELATED SECTIONS

A. Section 40 05 12 – Hangers/Supports

1.03 REFERENCES

A. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
B. ASME B16.3 - Malleable Iron Threaded Fittings.
C. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
D. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
E. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

1.04 SUBMITTALS

A. Submit product data showing that the proposed material meets the specifications under provisions of Section 01-33-00.
B. Product Data: Provide data on valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
C. Submit shop drawings or product data sheets of adapters between pipes and fittings of different materials.
D. Guarantees: All valves shall carry 1 year guarantee.

1.05 PROJECT RECORD DOCUMENTS

A. Record actual locations of buried valves.

1.06 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.07 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 documented experience.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect products at the site from the atmospheric element.
B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
C. Provide temporary protective coating on cast iron and steel valves.

1.09 CLOSE OUT SUBMITTALS

A. Provide one plug valve wrench for every five plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.

PART 2 - PRODUCTS

2.01 GENERAL

A. All valves of each type shall be the product of one manufacturer.
B. Valve joints shall match adjacent pipe. Generally, all valves of 3" or larger shall be flanged for above ground applications and mechanical joints for buried locations.
C. All valves located inside manholes shall be equipped with extension stems and floor boxes so valve can be operated from outside the manhole. Supply intermediate stem supports as required. This requirement does not apply to valve vaults for pump stations.
D. All buried valves shall be equipped with extension stems to extend the operator nut to 6" to 12" below finish grade. Supply "spider" supports or other supports to center extension in box.

2.02 VALVES

A. Ball Valves:
   1. Up to and including 2 Inches: Bronze one piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, solder or threaded ends with union.
   2. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 inches and over, NIBCO flanged.
   3. Ball valve manufacturers shall be Jamesbury, Worchester, Apollo or as approved by the Engineer.
B. Check Valves - PVC/CPVC
   1. Ball check valves shall be supplied for PVC or CPVC piping. Ball valves shall be full port and true union type.
   2. PVC or CPVC Ball valves and ball check valves shall be as manufactured by Chemtrol, Nibco, Hayward or approved by the Engineer.
C. Butterfly Valves
   1. 4 inches or larger: Iron body, ANSI class 125, shall be lugged style. Valves shall have a mechanically retained seat and shall provide a tight shut-off on dead-end or isolation service without the use of downstream flanges. Discs shall be cast iron and shaft shall be 416 stainless steel and be supported on three self-lubricated bronze bearings. Shaft seals and seats shall be EPDM. Valves 8" and larger shall have a totally enclosed weatherproof gear operator. Valves shall be Dezurik Fig. BIF Keystone Bray equivalent or as approved by the Engineer.
D. Gate Valves
   1. 2 Inches and smaller: Bronze body, non rising stem and handwheel, inside screw, solid wedge disc, screwed ends, manufactured by Lunkenheimer #1962, Jenkins, Crane or as approved by the Engineer.
   2. Over 2 Inches: Iron body, bronze trim, non rising stem, flanged ends, manufactured by U.S. Pipe, Clow, East Jordan Iron Works, Engineer.
E. Globe Valves
   1. Up to and including 2 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity (repackable under pressure).
   2. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
   3. Globe valve manufacturers shall be Jenkins, Crane, Stockham or as approved by the Engineer.
F. Plug Valves
   1. Up to and including 2 Inches: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends.
   2. Over 2 Inches and under 6 Inches: Cast iron body and resilient lined plug, non-lubricated, Teflon packing, flanged ends.
   3. Plug valves 6 Inches and over shall have cast iron body, resilient lined plug, stainless steel bearings, flanged ends, extended bonnet for buried and submerged valves. Operating stem with 2" square nut shall be extended to within 6 inch of finish grade within valve box for valves.

4. Valves shall be as manufactured by Milliken or D. Zurik.

2.03 CHECK VALVES

A. Silent Check Valve:
   1. Construction:
      a. Ductile Iron – Body.
      b. Bronze – Trim.
      c. Buna-N Rubber – Seating.
      d. Globe Style – Flange Joints.
      e. Stainless Steel – Spring.
   2. Valve shall be an APCO Series 600 or Golden Anderson Fig. 288.

B. Ball Check Valves:
   1. The valves shall be constructed with a ductile iron housing and cover, conforming to ASTM A 536 ductile iron. The o'ring shall be made from Buna, and the ball will be hollow aluminum filled with foundry sand and coated with buna material. The ball has to be concentrically weighted, so it will constantly rotate in the housing to clean itself automatically. The bolting shall be Zinc-coated steel and the connections shall be ASA 125# flanges.
   2. The maximum working pressure shall be 145PSI and the maximum temperature 176°F. The ball will be the only moving part in the valve and to inspect or replace it only two bolts need to be removed.
   3. Valves shall be HDL Type 5087 as manufactured by HDL, Inc.

C. Swing Check Valve:
   1. 2 Inches and smaller: Bronze body, regrinding bronze disc, screwed ends, screwed cap and stop plug, manufactured by Lunkenheimer #624, Jenkins, Crane or as approved by the Engineer.
   2. Over 2 Inches: Iron body, bronze trim, regrinding bronze disc and seat ring, flanged ends bolted cover, manufactured by Lunkenheimer #323, Jenkins, Crane, APCO, Clow, or as approved by the Engineer.

D. "Duckbill" Elastomeric Check Valves
   1. Check Valves are to be all rubber and the flow operated check type with a flanged end connection. The port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow. The flange and flexible duckbill sleeve shall be one piece rubber construction with nylon reinforcement. The bill portion shall be thinner and more flexible than the valve body, and formed into a curve of 180°.
   2. The flange drilling shall conform to ANSI B16.1 Class 125/ANSI B16.5, Class 150 standards. The valve shall be furnished with steel back-up rings for installation.
   3. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name, plant location, valve size and serial number shall be bonded to the check valve. Valves shall be manufactured in the USA.
   4. All valves shall be of the Series 37 as manufactured by Tideflex Technologies Inc. of Pittsburgh, PA General Rubber or approved equal.

2.04 AIR AND AIR/VACUUM RELEASE VALVES

A. Standards:
   1. Valves shall be fully automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. Valves shall be suitable for working pressure up to 150 psig.
   2. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.
   3. Materials:
      a. The valve body, cover, and baffle shall be constructed of ASTM A126 Class B cast iron.
      b. The float, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Resilient seats shall be Buna-N.
   4. Connections:

a. Valve shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection.

B. Air Release Valves (Potable Water):
1. Standard Additional:
a. Valve shall withstand 500 psi test pressure.
b. Venting capacity shall be 55CFFAA at 150 psi.
2. Valve Finish:
a. Valve Interiors and exteriors shall coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550.
3. Manufacturer shall be:
a. APCO Model, 200A, by Valve & Primer Corporation: Schaumburg, IL.
b. Series 33A by CLA-VAL, Newport Beach, CA.

C. Air/Vacuum Release Valve:
1. Standard Additional:
a. The exterior of the valve shall be coated with a universal alkyd primer.
b. Valve body shall have 2” NPT cleanout and 1” NPT drain connections on the side of the casting.
c. Includes bronze shut-off valve and backwash water supply hose.
2. Manufacturer shall be:
a. CLA-VAL Model 35WWBW, CLA-VAL, Newport Beach, CA.
b. APCO Model, 401SAVV, by Valve & Primer Corporation: Schaumburg, IL.

2.05 ACCESSORIES

A. Valve Boxes:
1. Install Valve boxes over all underground Valves.
2. Valve boxes shall extend to finish grade.
3. Install Valve boxes plumb and concentric with the valve stem.
4. Provide extended nuts to 6” of finished grade for valves deeper than five feet.
5. Valve boxes shall be three-piece, screw type boxes, Clow F-2450; or equal.

B. Motor Operators:
1. Electrical characteristics for motor operators shall be 480 volt, 3 phase, 60 Hz.
2. Motor enclosures shall be NEMA 4.
3. Manual operation with declutching hand wheel.
4. Torque limiting feature to prevent valve or actuator damage.
5. Limit switches indicating open and closed positions.
6. Motor Operators shall be Limitorque, Rotork Auma, or Approved Alternate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide clearance for installation of insulation and access to valves and fittings.
C. Install valves with stems upright or horizontal, not inverted.
D. Provide one plug valve wrench for every five plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.
E. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
F. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
G. Install globe or ball valves for throttling, bypass, or manual flow control services.
H. Provide spring loaded check valves on discharge of water pumps.
I. Flush Connections shall be installed in tapped bosses in the pipe fitting closest to the location indicated on the plans, or in a tapped blind flange or companion flange.
J. All ball check valves shall be mounted vertically with flow in the upward direction whenever possible.

END OF SECTION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes material and requirements for identification processing piping pumps, valves and appurtenances.
B. Related Requirements:
   1. Process Paint.

1.02 REFERENCES

A. Reference Standard:
   1. ANSI/ASME A13.1 Scheme for the Identification of Piping Systems.

1.03 ACTION SUBMITTALS

A. Product data:
   1. Submit list of wording, symbols, letter size, and color coding for identification.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Color: For additions to existing systems, match existing; for new systems, unless specified otherwise, conform with ANSI/ASME A13.1.
B. Devices:
   1. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on white background.
   2. Plastic Tags: Laminated three-layer plastic with engraved black letters on white background color. Tag size minimum 1-1/2 inch square.
   3. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
   4. Stencils: With clean cut symbols and letters of following size:
   5. Stencil Paint: Semi-gloss enamel.
   6. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.
C. Device Sizes:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
3/4" - 1-1/4"	8"	1/2"
1-1/2" - 2"	8"	3/4"
2-1/2" - 6"	12"	1-1/4"
8" - 10"	24"	2-1/2"
Over 10"	32"	3-1/2"
Ductwork and Equipment	---	2-1/2"

2.02 SUPPLIERS

A. Seton Name Plate Company.
B. Craftmark Identification Systems.
C. Substitutions: Under provisions of Section 01600.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Fixtures to be identified:

1. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners, or adhesive.
2. Plastic or Metal Tags: Install with corrosive-resistant chain.
3. Stencil Painting: Apply in accordance with manufacturer's recommendations.
4. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

Equipment: Identify pumps, tanks, and panels with plastic nameplates. Small devices, such as in-line pumps and instruments, may be identified with plastic or metal tags.

B. Devices:

1. Controls: Identify control panels and major control components outside panels with plastic nameplates.
2. Valves: Identify valves in main and branch piping with tags.
3. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for the testing of the control system, consisting of the PLC system , motors, variable frequency drives, the primary devices, primary elements, chemical feed equipment and all main control MCP enclosures and wire/cable connected to the control system.

B. Related Requirements:
1. Electrical 26-nn-nn.
2. Process Series 40-nn-nn.

1.2 REFERENCES

A. Abbreviations:
1. PLC – Programmable Logic Controller.
2. MPC – Main Control Panel.
3. CPU – Control Processing Unit.

B. Reference Standards:
1. All equipment and workmanship shall be in conformance with the following documents:
   a. National Electrical Code (NEC), latest approved edition.
   b. Any and all Federal, State, and/or local codes, ordinances, or regulations.
2. All equipment shall be designed, constructed, installed, and 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.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Scheduling:
1. The Contractor shall formally schedule the commissioning with the Engineer a minimum of thirty (30) days prior to the proposed commissioning date. Included with this notification shall be the proposed hardware commissioning procedures for the Engineer to review. These procedures shall include all steps proposed by the Contractor to prove that the intent of the commissioning is accomplished and steps to temporarily suspend commissioning should the number of deficiencies becomes excessive.
   a. Commissioning cannot begin until all required hardware, primary devices, required software, and necessary documentation is in place.

PART 2 – PRODUCTS – NONE

PART 3 – EXECUTION

3.1 PREPARATION

A. Field Testing:
1. Field inputs to each PLC shall be activated at the field device and the signal verified in the memory of the PLC. In addition, each wiring circuit shall be tested for continuity, short circuits, and ground faults.
2. Final calibration of all instrumentation shall be performed during the commissioning effort. All power supplies shall be adjusted to their final settings. The Contractor shall complete a calibration certificate for each instrument installed under this contract. The certificate shall be signed by the Contractor’s field technician and indicate values tested, expected values, actual values obtained, and accuracy. Completed certificates shall be submitted to the Engineer for record purposes.

B. The following shall occur prior to scheduling demonstration and training of any equipment and/or system:

1. The Contractor shall have fully complied with Calibration and Start-up of Systems, and shall have submitted reports indicating successful completion of start-up for the equipment/system being started.
2. Any 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 the Owner's Demonstration and Training.
3. The Contractor shall submit for approval a proposed agenda for said demonstration/training, and shall adhere to the approved agenda for the demonstration and training session(s).
4. Any and all test equipment, maintenance equipment, tools, or devices, and/or spare parts required to be furnished shall be turned over, and stored as required.

C. After completing the above items, the Contractor shall schedule the Owner's Demonstration and Training. Seventy-two (72) hours (minimum) written notice shall be given the Owner's Representative prior to performing any Demonstration and/or Training. Such sessions shall be scheduled at a time agreed upon by the Owner and the Contractor. Multiple sessions shall be scheduled to allow attendance by all Owner's Personnel.

3.2 DEMONSTRATION

A. Demonstration of equipment and systems, and training of the 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 Demonstration shall instruct the Owner's personnel in all 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 the Owner's personnel in identifying improper operation, troubleshooting for the causes(s), and performing repair, replacement, and recalibration/setup necessary to correct the mis-operation. Use of any test equipment necessary, and a review of any recommended and/or provided spare parts shall be included in the Training.

C. Verification of the Demonstration and Training for the equipment and/or system shall be provided in the form of a report, indicating that the 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 the Owner's Representative and four (4) copies of all demonstration and training reports, as specified above and in other Sections, shall be submitted to the Owner.

3.3 CONTRACTOR'S ASSISTANCE

A. Demonstration and Training of Package Equipment shall be as required in other Sections of these Specifications.

B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturers' service representatives on any and all field set-ups and adjustments as may be required to demonstrate operation of the equipment or system. The Contractor shall make equipment manufacturers' service representatives available as required to assist in demonstrating equipment operation.

3.4 ACCEPTANCE

A. 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.

B. Acceptance of equipment and/or systems shall be signified by execution of Guarantees as described below.

3.5 GUARANTEES

A. The equipment and installation furnished shall be guaranteed for a period of one (1) year.

B. The Contractor's Guarantee shall be furnished as follows:
1. Provide duplicate notarized 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 all work and materials provided and installed under this Division.
3. Execute and assemble any and all transferable warranty and/or license documents from Subcontractors, suppliers, and manufacturers.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE

A. The work covered by this Section of the specifications consists of furnishing all labor, equipment, and materials in connection with the testing of the control system, consisting of the PLC system, motors, variable frequency drives, the primary devices, primary elements, and all control enclosures and wire/cable connected to the control system.

1.2 RELATED SECTIONS

A. SECTION 01-33-00 SUBMITTALS
B. SECTION 26-19-13 ENCLOSED MOTOR STARTERS
C. SECTION 26-29-23 VARIABLE FREQUENCY DRIVES
D. SECTION 40-95-00 PRIMARY DEVICES
E. SECTION 40-95-73 CONTROL, SIGNAL, AND COMMUNICATION WIRING

1.3 SUBMITTALS

A. Submit under provisions of Section 01-33-00 and this paragraph.
B. Test Procedure Submittal Schedule:
   1. Commissioning: minimum thirty (30) days prior to scheduled test.
C. Submittal format:
   1. For all submittals, three (3) complete sets of hard print-out in binders of all proposed test procedures.

PART 2 – PRODUCTS NONE

PART 3 – EXECUTION

3.1 COMMISSIONING

A. Commissioning of the PLC system shall be performed by the Contractor and the Owner provided PLC programmer. The purpose of the commissioning effort is to demonstrate that all systems and components are installed and function as intended by the Specifications and Drawings.
   1. Scheduling – The Contractor shall formally schedule the commissioning with the Engineer a minimum of thirty (30) days prior to the proposed commissioning date. Included with this notification shall be the proposed hardware commissioning procedures for the Engineer to review. These procedures shall include all steps proposed by the Contractor to prove that the intent of the commissioning is accomplished and steps to temporarily suspend commissioning should the number of deficiencies becomes excessive.
      a. Commissioning cannot begin until all required hardware, primary devices, required software, and necessary documentation is in place.
   2. Field inputs to each PLC shall be activated at the field device and the signal verified in the memory of the PLC. In addition, each wiring circuit shall be tested for continuity, short circuits, and ground faults.
   3. Final calibration of all instrumentation shall be performed during the commissioning effort. All power supplies shall be adjusted to their final settings. The Contractor shall complete a calibration certificate for each instrument installed under this contract. The certificate shall be signed by the Contractor's field technician and indicate values tested, expected values, actual values obtained, and accuracy. Completed certificates shall be submitted to the Engineer for record purposes.
   4. The Contractor shall supply all necessary personnel to perform the commissioning. The Owner and Engineer will only act as observers to verify the completeness of the commissioning.

3.2 FIELD TESTING

A. Field testing of the PLC system will be performed by the Contractor in the presence of the Engineer and Owner after the installation and commissioning of the PLC system by the Contractor. The purpose of the test is to demonstrate that all hardware and software performs as intended by the design of the PLC based system.

1. Scheduling – The field test will begin after the acceptable conclusion of the installation and commissioning effort. The Contractor will notify the Engineer in writing of the actual field test commencement date.
2. The Contractor shall supply start-up services as required to demonstrate proper operation of the PLC system to the satisfaction of the Engineer/Owner. Start-up services during the field test shall not exceed four hours per location, ten (10) locations in total. The duties of the start-up technician shall include, but not be limited to, recalibration of field devices, monitoring process values, troubleshooting control circuits, and tracing field wiring.

3.3 TESTING ACCESSORIES

A. The Contractor shall be responsible for supplying all required and necessary equipment to properly conduct the testing and commissioning required by this Section.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes requirements for and associated devices and appurtenances for Physical Measurement Devices.

B. Related Requirements:
1. 40-nn-nn Process.
2. 26-nn-nn Electrical.

1.2 REFERENCES

A. Reference Standards:
1. Conform to requirements of NFPA 70 National Electrical Code.
2. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose specified, and as indicated on the Drawings.
3. All 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.
4. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
   a. ANSI/ISA applicable standards for measurement and instrumentation.
   b. NEMA, including 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.

1.3 ACTION SUBMITTAL

A. Shop Drawings: Submittals shall be as required under provisions of Division 1.
1. 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.
2. 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.

1.4 INFORMATION SUBMITTAL

A. Test Reports: Submit panel shop test reports.

B. A copy of the manufacturer's configuration software and any necessary cables shall be provided to the Owner, for use in calibrating the pressure transmitter instruments. If software is not available, then two (2) handheld configurators shall be provided to the Owner.

1.5 CLOSEOUT SUBMITTALS

A. O & M 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.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing Devices as specified in this section with minimum five (5) years documented experience.

1.7 SITE CONDITIONS

A. Environmental:
1. Normal ambient temperatures at the Facility range from zero 0°F to 115°F.

PART 2 – PRODUCTS

2.01 EQUIPMENT – PRESSURE TRANSMITTERS

A. The Pressure Transmitters shall be Smart electronic Gage Pressure Transmitters used to convert pressure in PSI or Inches to a linear 4 to 20mA scale. It shall indicate level or Pressure as programmed. The unit shall be ABB 264HSM or Rosemount 3051 with a 316 Stainless Steel diaphragm and 316 Stainless Steel wetted parts. The unit shall have Stainless Steel bolts and nuts. Gaskets when needed shall be Teflon. The unit shall be supplied with Surge protection.

B. The transmitter shall include a Stainless Steel mounting bracket, 316 Stainless Steel block and bleed valve, and ½ NPT process connection. The transmitter shall output a 4-20mA output and be HART compatible. The accuracy of the transmitter shall be +/- 0.075% of span. The unit shall be stable for a period of 5 years or greater. Power shall be 10.5 to 42 Volts DC.
1. The Transmitter housing shall be made of Aluminum with a NEMA 4X rating. Provide a programmable LCD display for each unit and 1 smart Hand Held Calibrator for configuration and calibration. The unit shall have a Two Year warranty.
2. The unit shall be rated for Class 1 Division2 hazardous location.

C. Provide a pressure seal of the Iso-ring type.
1. The seal constriction shall consist of a body, 360 degree flexible elastomeric cylinder with positive O-ring type sealing arrangement, captive sensing liquid and 2 assembly flanges. The Iso-ring ID shall match the pipe line ID. The Iso-ring OD shall not exceed the ID of the piping flange bolt circle. Units shall be designed to fit 124-pound, 150-pound and 300-pound ANSI piping flanges as shown on the drawings.
2. Construction Features:
    1. Sensor Body and Flanges: Type 316 stainless steel.
    2. Sensor Sleeve: Buna-N.
    3. Sensing Liquid: Silicone filled.
    4. Instrument Connection: 1/2-inch NPT.
3. Assembly and Calibration:
    1. The complete pressure assembly, including transmitter, shall be factory assembled, filled and calibrated to the ranges prior to shipment.
    2. Location and orientation of the gages, switches and pressure element assemblies shall be coordinated with the actual piping and equipment

installations so that gages and indicators shall be easily read and accessed for maintenance by plant personnel.

3. Where field mounting and orientation conflicts arise due to incomplete coordination with or field changes in the process piping and equipment installation, assemblies shall be relocated, re-oriented, re-assembled and recalibrated as directed by the Engineer.

4. Manufacturer and Model:
   1. Red Valve Company, Series 40.
   2. Ashcroft, Type 80.
   3. Onyx Valve.
   3. Or equal.

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.

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes requirements for and associated devices and appurtenances for Physical Measurement Devices.

B. Related Requirements:
1. 40-nn-nn Process.
2. 26-nn-nn Electrical.

1.2 REFERENCES

A. Reference Standards:
1. Conform to requirements of NFPA 70 National Electrical Code.
2. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose specified, and as indicated on the Drawings.
3. All 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.
4. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
   a. ANSI/ISA applicable standards for measurement and instrumentation.
   b. NEMA, including 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.

1.3 ACTION SUBMITTAL

A. Shop Drawings: Submittals shall be as required under provisions of Division 1.
1. 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.
2. 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.

1.4 INFORMATION SUBMITTAL

A. A copy of the manufacturer's configuration software and any necessary cables shall be provided to the Owner, for use in calibrating the pressure transmitter instruments. If software is not available, then two (2) handheld configurators shall be provided to the Owner.

1.5 CLOSEOUT SUBMITTALS

A. O & M 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.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing Devices as specified in this section with minimum five (5) years documented experience.

B. Spare Parts:

1.7 SITE CONDITIONS

A. Environmental:
1. Normal ambient temperatures at the Facility range from zero 0°F to 115°F.

PART 2 – PRODUCTS

2.01 MAGNETIC FLOW METER (23.33)

A. Magnetic Flow Meters: Meters flow direction shall be "non-reversing" or "reversing" as shown on the drawings.
1. The Magnetic flow meter shall be of low frequency electromagnetic induction type and shall include a DC pulse signal directly proportional and linear to the liquid flow rate. The meter shall be designed for operation on 120V AC+/- 10%, 60 Hz +/- 5% with power consumption of less than 25 Watts. Meter must be a full bore meter with the magnetic field traversing the entire cross-section of the flow tube. Insert magmeters or multiple single point probes inserted into a spool piece are not acceptable.
2. All Meters shall have an ANSI 150# flanged unless otherwise dictated on the drawings. Meters 30 Inches and larger shall have an AWWA Class D Flange. Meter system must be fully rated to the same design pressure as the flanges. Flange-to flange laying length of the meter shall be ISO 13359 Standard.
   a. Flanged meters for Raw Sewage shall have a Polyurethane or Elastomer liner and Hastalloy C self cleaning bullet nosed electrodes.
   b. Potable Water Meters shall have an FDA or NSF approved liner.
   c. Chemical Feed meters shall have a Tefzel liner with electrodes and Grounding rings that are compatible with the Process fluid being measured.
3. Meter body shall be made of Stainless Steel and Flanges made of Carbon steel. Magnetic Flow Meters shall be furnished with two 316 or 304 Stainless Steel grounding rings. Only oraphice type grounding rings will be acceptable. Grounding electrodes or probes which penetrate the liner will not be acceptable.
4. The Magnetic Flow Meter shall be hydraulically calibration a facility traceable to National Bureau of Standards. A computer printout of the actual calibration data giving indicated versus actual flow at a minimum of three flow rates shall be provided with the meter. Manufacturer must have ISO 9000 Certification. The Flow Meter supplied shall be General Purpose, FM approved for Class I Division II areas or Class I Div I as indicated on the drawings. Accuracy of the meter shall be +/- 0.25% of the flow rate for maximum flow velocities from 0.7 to 33.33 feet per second and +/- 1.% of flow rate for flow velocities from 0.35 to 0.7 feet per second. Repeatability shall be 0.05% of span. Rangeability shall be 500:1 or greater.
5. Magentic Flow Meters below grade or in a meter vault shall be housed in an epoxy-coated Nema 6P enclosure and shall be capable of Continuous Submergence in up to 30 feet of water. All other meters shall be capable of Accidental Submergence.
6. Manufacturer shall be ABB, MFE, or equal.

B. Magnetic Flow Meter-Signal Converter:
1. Signal converter shall be microprocessor-based remote mounted, with a LCD display capable of simultaneously displaying flow rate and totalization. One conduit run between meter and converter.
2. The converter shall be 110Vac 60 Hz with isolated 4-20ma dc analog output proportional to the flow displayed on the LCD display.
3. The signal converter shall be NEMA 4X die cast aluminum housing with flow rate and totalization

indicator. Meters 14 inches or greater shall be rated for continuous submergence in 30 ft of water and have attached (at the factory) the cable of sufficient length to connect between the sensor and signal converter without any splices or intermediate terminations.

PART 3 – EXECUTION

3.1 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.

3.2 FIELD QUALITY CONTROL

A. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this Section of the specifications consists of furnishing all labor, equipment, and materials in connection with the supply and installation of the devices specified and appurtenant work.

1.2 RELATED SECTIONS

A. SECTION 26-05-19 WIRES, CABLES, SPLICES, TTTERMINATAIONS
B. SECTION 40-80-10 CONTROL SYSTEM TESTING

1.3 QUALITY ASSURANCE (01-33-00)

A. Submit product data:
   1. Material list of items proposed to be provided under this Section.
   2. Manufacturer's product data and other related information to prove compliance with specified requirements.
   3. Manufacturer's installation procedures.
C. Shop Drawing Submittal Schedule:
   1. For initial review, within sixty (60) days of the notice to proceed.
   2. Final, after Substantial Completion but before Final Payment.
D. Operation and Maintenance manuals shall be provided for all equipment provided under this Section prior to Final Payment.
E. Submittals for each training session shall include course itinerary, list of training material handouts, and instructor resume.
   1. Submittals of required training information shall be made to the Engineer at least 30 days prior to the training date.

1.4 QUALIFICATIONS

A. Manufacturers specializing in manufacturing the Products specified in this Section with minimum three years documented experience, and with authorized technical service facilities within 150 miles of Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site according to manufacturers' recommendations and accepted trade practices.
B. Accept products on site in factory containers. Inspect for damage.
C. Store products in clean, dry area; maintain temperature within limits acceptable to the manufacturer.

1.6 MAINTENANCE SERVICE

A. Furnish manufacturer's service and maintenance of all materials furnished under this Section for one year from the Date of Substantial Completion.
B. All materials furnished under this Section shall be warranted for a minimum of one year from the Date of Substantial Completion.

1.7 QUANTITIES

A. All products specified as part of this Section shall be provided in quantities as required by contract documents.

PART 2 PRODUCTS

2.1 MATERIALS

A. Shall conform to the following requirements. Configuration and quantities of devices shall be as specified or shown on the Drawings. Should additional appurtenances be required, but not specifically indicated here or elsewhere, in order to effect the intent of the contract documents, such appurtenances shall be provided.

2.2 MANUFACTURER REFERENCES

A. The system described and shown by the Contract Documents has been designed around the manufacturers identified. The materials from these manufacturers must be used is the base bid. Substitutions to the listed manufacturers must be identified in the bid documents.

2.3 POWER SUPPLY

A. Shall be properly sized for all instrumentation and communication devices provided at each location. The power supply shall be housed in the same enclosure as the modular controller and communication equipment. Power supply input shall be 120 VAC and output shall be as required by particular device. Power Supply shall be Sola.

2.4 NOT USED

2.5 PUSHBUTTONS

A. Shall be used for manual operator interface with the system.
B. The pushbuttons shall include a legend plate and have the same NEMA rating as the enclosure they are to be mounted on.
C. Type: Monetary or Maintained as indicated on the Contract Drawings.
D. Contact arrangements shall be as required (minimum 1 NO and 1 NC) with each contact rated for 10 amps at 120 VAC.
E. Colors shall be as selected by the Engineer to meet Owner standards.
F. Pushbuttons shall be Allen-Bradley 800H.

2.6 NOT USED

2.7 PILOT LIGHTS

A. Shall be used for visual indication of various signals.
B. Pilot lights shall include a legend plate, be push-to-test transformer type, 120 VAC, and have the same NEMA rating as the enclosure they are to be mounted on.
C. Colors shall be as selected by the Engineer to meet the Owners standards.
D. Pilot lights shall be Allen-Bradley 800H.

2.8 POWER RELAYS

A. Relays shall be direct drive cartridge type, with 120 VAC coils and contacts rated for 20 amps continuous at 120 VAC. Contact arrangement shall be two (2) N.O. as a minimum, but as required for the application. Each relay shall mount in panels. Relays shall be Allen-Bradley, Bulletin 700, Type PK.

2.9 CONTROL RELAYS

A. Relays shall be general purpose, plug-in, "ice cube" type, with 120 VAC coils and contacts rated for 10 amps at 120 VAC. Contact arrangement shall be DPDT as a minimum, but as required for the application. Each relay shall have pin connections and include a tube base for mounting in panels. Relays to be installed as required to provide proper signals. Relays shall be Allen- Bradley, Bulletin 700, Type HA, or equal.

B. Relays used for communication polling shall be plug-in, "ice cube" type, with 24 VDC coils and LED indication. Relays shall be Allen-Bradley, Bulletin 700, Type HK.

2.10 FLOATS

A. Floats shall be provided for the locations and services shown on the drawings, as specified, or as scheduled.
B. Floats shall consist of a chemical resistant polypropylene casing encapsulating a single pole solid state switch which activates when the longitudinal axis of the float is horizontal, and deactivates when the level falls one inch below the actuation elevation.
C. Floats shall contain no mercury.
D. Floats shall include a collar or cord weight to minimize drift. Float cable shall be of lengths as required to keep all terminations of wires in the control panel and not in the pit. (to be field verified by the contractor)
E. Floats shall be of a specific gravity specifically suited for water.
F. Power cord shall be 2 conductor #16 flexible cord type SJOW oil resistant, rated for 300 volts.
G. Manufacturer shall be Flygt, or equal.

2.11 DIGITAL INDICATORS

A. Indicators shall provide a clear, digital display of process variable values. Digits shall be red and 0.56 inches in size. A minimum 4 digits (seven segments each) shall be viewable.
B. Power requirements shall be 120 VAC, 60Hz. Unit shall be panel or surface mount.
C. Indicators shall accept input signals of 4-20 mA, with an input impedance of less than 130 ohms.
D. Display shall be calibrated in engineering units, specific to the process variable displayed and expected signal range.
E. Provide programming cable/adapter/converter and configuration software on disk. One (1) required for the project/contract.
F. Indicators shall be Precision Digital, PD765.

2.12 MOTOR STARTER SURGE SUPPRESSORS

A. Surge suppressors shall be installed on all existing motor starter coils that are interfaced to modular controller outputs. Surge suppressors shall be sized for the specific motor starter. Surge suppressors shall be Allen-Bradley, Bulletin 100, Catalog No. 199-FS or 599-K, or equal.

2.13 TIME DELAY RELAY

A. The time delay timer specified under this subpart shall capable of providing an on delay adjustable from the front of the device.
B. Input power: 110VAC (+10%, -20%).
C. Output: DPDT 10 Amp @ 30VDC, 240VAC relay. Rated 10 amps resistive @ 30 VDC or 250 VAC (or less).
D. The contact material shall be Silver Cadmium Oxide with a life of 100,000 operations under load.
E. Unit shall be plug–in provided with a DIN rail mountable 8-pin octal socket. Unit shall be U.L. approved.
F. The range shall be 0.3 or 3 Seconds, Minutes or Hours. Dial selectable.
G. Manufacturer shall be Allen-Bradley, 700-HT12BU120.

2.14 SUBMERSIBLE LEVEL SENSOR

A. The sensor specified under this subpart shall capable of providing a 4-20mA signal proportional to the well level. With 3” diameter opened faced Teflon coated sensor for waste water applications.
B. Pressure Range: 0-20 ft.
C. Operating Temperature Range: 20 to 185 degrees F.
D. Compensated Temperature Range: 40 to 120 degrees F.

E. Static Accuracy: ± 0.10%

F. Wetted Parts: 316 SS or Titanium.

G. Power: 9-30DVC loop powered.
H. Output: 4-20mA signal.
I. Circuit Protection: Polarity surge/short output.
J. Cable: Self-seal polyurethane jacket shielded cable with polyurethane vent. Electrical conductors shall be minimum 22AWG. Tefzel jacket with 90 lbs pull weight.
K. Shall be FM intrinsically safe design.
L. Cable length shall be:
    1. Determined by the engineer.
M. Manufacturer shall be Viatran, Model WW517.
N. Provide a spare Level sensor with the required cord length for each station.

2.15 Limit Switches (mechanical type)

A. Limit switches shall have a contact arrangement as shown on the drawings, or as required. Contacts shall be rated 6 amp at 120 VAC.
B. Switch shall have ½" conduit threads on housing.
C. Shall have 3" lever arm with roller on end.
D. Mechanical Limit switches shall be manufactured by Allen Bradley 802T-A type, Cutler Hammer, Square D, or Equal.

2.16 Radar Level Controller

A. Vega PULS WL61 Radar level controller
B. Cord Length: 49.2 feet

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with published manufacturer's instructions and standard trade practices.
B. Do not install products until major construction is complete and building interior is enclosed and heated.
C. Connect equipment and devices as indicated.
D. Provide conduit and wiring as required to provide process interface signals as indicated on drawings.

3.2 FIELD QUALITY CONTROL

A. Field inspection, commissioning, and testing will be performed under provisions of the contract documents.
B. Perform operational testing on equipment and devices to verify proper operation and field wiring connections.

3.3 CALIBRATION

A. All devices, including power supplies, shall be adjusted to their final settings during calibration.

PART 4 SPECIAL PROVISIONS - NONE

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes requirements and for and associated devices and appurtenances for Instrument/Control Panels.
B. Related Requirements:
   1. 40-nn-nn Process.
   2. 26-nn-nn Electrical.
   3. 27-nn-nn
   4. 28-nn-nn

1.02 REFERENCES

A. Abbreviations:
   1. I&C – Instrument and Control.
   2. LR – Logic Relays.
B. Reference Standards:
   1. Conform to requirements of NFPA 70 National Electrical Code.
   2. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), as specifically indicated as acceptable to the authority having jurisdiction, and as suitable for purpose specified, and as indicated on the Drawings.
   3. All 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.
   4. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
      a. ANSI/ISA applicable standards for measurement and instrumentation.
      b. NEMA, including 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.

1.03 ACTION SUBMITTAL

A. Shop Drawings:
   1. 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.
   2. 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.

1.04 INFORMATION SUBMITTAL

A. Test Reports: Submit panel shop test report.

1.05 CLOSE OUT SUBMITTALS

A. O & M Date:
   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 ASSURANCE

A. Manufacturer: Company specializing in manufacturing Control Panels as specified in this section with minimum five (5) years documented experience. Manufacturer shall be a UL Listed panel fabricator, and shall submit certification of Listing immediately after the Start of Contract.
B. Spare Parts:

1.07 SITE CONDITIONS

A. Environmental:
1. Normal exterior ambient temperatures at the Facility range from zero 0°F to 115°F.
2. Interior ambient temperature range from 20°F to 110°F.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Other devices and sensors noted elsewhere.
B. Blocks:
1. Terminal Blocks – 600 Volts and Less:
a. Terminal blocks shall be "Finger-Safe" style with screw with pressure plate as manufactured by Allen Bradley 1492-H1, or approved equivalent, by 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. Power Distribution Blocks – 600 Volts and Less:
a. Power distribution blocks shall be as manufactured by Allen Bradley 1492-PD type, or equal, by 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.
C. Switches and Indicating Lights:
1. Push-button switches, selector switches, and full voltage LED type indicating lights mounted on NEMA Type 1, or NEMA Type 12, enclosures shall be of dust-tight, oiltight NEMA Type 13 design with "Finger-Safe" terminals; as manufactured by Allen-Bradley Bulletin 800TC.
2. 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 800TC with clear rubber boot and gaskets.
D. Indicating Lights (LT:
1. Indicating lights shall be heavy duty, push-to-test, transformer type LED with lens colors as shown on the Drawings.
2. 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.

E. Selector Switches:
1. 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.

2. 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.

F. Push-Button Switches (PB)
1. 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.
2. 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.

G. DC Loop Power Supplies:
1. Separately mounted DC power supplies shall be as manufactured by Phoenix Contact, Acopian, or Power-One.

H. DC Power Supplies:
1. 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.
2. Separately mounted DC power supplies shall be as manufactured by Phoenix Contact, Acopian, or Power-One.

I. Panel Heaters:
1. Heaters shall be as manufactured by Hoffman Engineering, or equal. Heaters shall be provided complete with thermostat, ranged 40 to 100 degrees Fahrenheit.
2. 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.

J. Logic Relays (LR):
1. 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.
2. 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.
3. 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.
4. 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.

2.02 INSTRUMENT & CONTROL (I&C) PANELS - GENERAL

A. Manufacturer(s) of the Instrument & Control Panels shall be a U.L. Listed Industrial Control Panel Fabricator.
1. Instrument and Control Panels shall be furnished as described in these Specifications and as indicated on the Drawings.
2. Unless otherwise noted, I&C panels shall be of Type 4 stainless steel. Where noted, control panels shall be NEMA Type 4 stainless steel.
3. Construction of all panels shall be adequate to properly support all devices and equipment mounted in and on the enclosure without bending or sagging. Panel layout and equipment spacing shall be sufficient to allow for device removal and maintenance without disassembly of adjacent devices. Interior and exterior panel shop drawings shall reflect dimensioned clearance of all panel-mounted devices.

4. All front panel-mounted equipment requiring connection and/or service from the rear or inside of the panels shall be furnished with an identification plate mounted on the rear in duplicate to the front panel identification. All equipment devices mounted within the panels shall be identified as to function and schematic identification abbreviation.

5. Plastic wireway shall be used to train wires in all cabinets. Wireway fill shall not exceed 40% and shall be run in continuous lengths with snap on plastic covers.

B. Pilot lights, switches, and other panel devices shall be furnished with anti-rotation key ways or other to prevent slewing after mounting.

C. Each wire and terminal shall be labeled with a wire number generated by the instrument manufacturer. Each and every wire shall be tagged at both ends within three inches of each terminal. Tags shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab 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.

1 All 4-20 mADC analog instrument signals shall use 3-pair No. 18 AWG shielded cable and shall be run in a separate raceway system from all 120 VAC control and power wiring.

2. All 120 VAC controls, and 12 or 24 VDC alarm wiring shall be No. 14 AWG. Unless otherwise noted, No. 14 AWG control and alarm wiring shall be Type MTW/THHN single conductor 600 volt, stranded, annealed copper, high temperature polyvinyl chloride, insulation with nylon jacket, oil land gasoline resistant, for use in indoor and outdoor applications, and wet and dry locations. Standard requirements to be met are ICEA Standard S-61-402 and UL Standard 83 for 75 degrees C.

3. Wiring shall not be spliced. Wire shall be run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.

4. Each wire for external connection, or for connection between subplate and door, shall be terminated on screw type terminals. Ten percent (10%) spare terminals shall be provided.

5. 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. Each of the I&C Panels shall contain all the instruments, devices, and equipment in accordance with and as required to afford the operations for the systems herein described.

E. All fused terminals, terminal blocks, pilot lights, push buttons and selector switches shall be provided with “Finger-Safe” terminals.

F. All exposed (Non-Finger-Safe) terminals, carrying a voltage greater than 50 volts, shall be covered with a protective shield to prevent accidental contact while servicing the panel or the devices housed within.

2.02 I & C PANELS – WALL MOUNT

A. Unless otherwise noted, wall or track mounting panels shall be of NEMA Type 12, 14 gauge minimum cold rolled sheet steel construction with gasketed doors equipped with locking handle, all panels keyed alike, with six (6) keys provided.

B. The wall or rack mounted panels shall be equipped with a duplex service receptacle, and circuit breakers for instrumentation power distribution, as required, or as shown on the Drawings.

C. Manufacturer shall be Hoffman – Concept Series with two-point latch or approved equivalent.

2.04 ASSEMBLY FABRIC

A. Front panel identification plates shall be 1” X 3” engraved white lamicoid with black letters, internal device identification plates may be smaller; both types shall be attached with corrosion resistant screws. Rear of panel face identification plates shall be attached with silicon adhesive. All engraved legends shall be a minimum 3/16” high block type characters. Legends shall be completely worded without abbreviations, except as approved by the Owner.

B. All steel panels and subpanels shall be thoroughly cleaned and bonderized or cold phosphated before painting. Panels shall be spray painted with two (2) coats of primer, and two (2) coats of finish hi-gloss epoxy enamel on both inside and outside surfaces. Inside surface shall be white and outside shall be ANSI 61 light grey, unless otherwise noted on the Drawings. Stainless steel and fiberglass panels shall not be pained, unless otherwise indicated on the Drawings.

2.05 QUALITY CONTROL

A. Shop Testing:
   1. The test procedure shall be performed at the manufacturer's factory prior to shipment of the equipment. The manufacturer shall notify the Engineer at least four (4) weeks before the factory testing in order that the test may be witnessed. The test results shall be fully documented and a copy of the test results shall be furnished to the Engineer for his records.

B. Preliminary Acceptance Testing:
   1. The same test procedure with supporting documentation shall be performed after installation to determine if damage has occurred during transit or installation. Successful completion of this field test will constitute the preliminary acceptance testing of the equipment for a given site.

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.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 16960.
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 16970.
B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

A. The work covered by this section of the specifications consists of furnishing all labor, equipment, and materials required for the wire and cable that will be incorporated into the work.

1.2 RELATED SECTIONS

A. SECTION 40-95-00 PRIMARY DEVICES

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS (01-33-00)

A. Submit product data:
   1. Material list of items proposed to be provided under this section.
   2. Manufacturer's product data and other related information to prove compliance with specified requirements.
   3. Shop drawings in sufficient detail to show fabrication, installation, and interface of the work of this section with that of other sections and other trades.
   4. Manufacturer's recommended installation procedures.

B. Test Reports: Indicate procedures and values obtained.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.7 FIELD SAMPLES

A. Submit two lengths, each 18 inches of cable assembly from each reel.
B. Select each length to include complete set of manufacturer markings.
C. Attach tag indicating cable size and application information.

1.8 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.
B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
D. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Shall conform to the following requirements. Configuration and quantities of devices shall be as specified or shown on the drawings. Should additional appurtenances be required, but not specifically indicated here or elsewhere, in order to effect the intent of the contract documents, such appurtenances shall be provided.

2.2 MANUFACTURER REFERENCES

A. The system described and shown by the Contract Documents has been designed around the manufacturers identified. The equipment from these manufacturers must be used is the base bid. Substitutions to the listed manufacturers must be identified in the bid documents.

2.3 WIRE AND CABLE - GENERAL

A. All wire and cable shall be delivered in full coils or reels and be protected from damage at all times. UL tags indicating the manufacturer, type, size, insulation grade, and length of wire in each coil or reel shall be securely attached to each coil or reel.

2.4 POWER WIRE AND CABLE

A. Description: Single conductor insulated wire.
B. Conductor: Copper for all size wire.
C. Insulation Voltage Rating: 600 volts.
D. Insulation: ANSI/NFPA 70, Type THHN/THWN.

2.5 CONTROL WIRE

A. Shall be of the type listed herein meeting the specifications noted.
   1. All control conductors shall be soft drawn annealed, stranded copper wire of 98% conductivity, with THHN or THWN insulation for 600 volt service. All control wires shall be No. 14 AWG or larger.
      a. All control wires prewired into control enclosures shall be minimum No. 16 AWG.

2.6 SIGNAL CABLE

A. All signal cable (4-20 mA, 1-5 VDC) shall be two conductors stranded copper wire, minimum No. 16 AWG with a minimum No. 18 drain. Cable shall have 100% foil shield and PVC jacket.
   1. For cabling in raceways not subject to water accumulation, cable shall be Belden 8719, or equal.
   2. For cabling installed in raceways that are buried or subject to water accumulation, cable shall have a water resistant jacket. Cable shall be Belden 9342, or equal.
   3. All signal cables prewired into control enclosures shall be minimum No. 18 AWG with a minimum No. 20 drain wire.

2.7 Resistance Temperature Detector (RTD) CABLE

A. All RTD signal cable shall be three conductors silver plated copper wire with shield, minimum 20 AWG.
   1. For cabling in raceways not subject to water accumulation, cable shall be Watlow

Electric Manufacturing Co., 701 series or equal.

2. For cabling installed in raceways that are buried or subject to water accumulation, cable shall have a water resistant Fluorinated Ethylene-Propylene (FEP) jacket. Cable shall be Watlow Electric Manufacturing Co., 704 series or equal.

2.8 ETHERNET CABLE

A. Horizontal Unshielded Twisted Pair (UTP) Cable:
   1. General: Horizontal cabling is the cabling between the ethernet resident device and the ethernet switch.
   2. The cable shall consist of 24 AWG thermoplastic insulated solid conductors formed into four individually twisted pairs and enclosed by a thermoplastic jacket.
   3. The cable shall meet all requirements of ANSI/TIA/EIA-568-A, part 10.2.
   4. The cable shall be plenum rated.
   5. The cable shall be rated for Category 6A use.
   6. Manufacturer: Provide one of the following:
      a. ATT Plenum LAN Cable;
      b. Belden;
      c. Or equal.

B. Connecting Hardware for Unshielded Twisted Pair (UTP) Cable:
   1. Hardware used to terminate UTP cable shall meet all requirements of ANSI/TIA/EIA-568-A, part 10.4.
   2. The connecting hardware shall be compatible with the wiring specified in 2.03.A.
   3. Connecting hardware shall be rated for Category 5 use.
   4. Connectors:
      a. Connectors shall utilize RJ45 (8 pin modular) plug/receptacle configuration.
      b. Connectors shall utilize T568B pin/pair assignments.
      c. Connectors shall be coordinated with wire type (solid or stranded conductor).
      d. Manufacturers: Provide one of the following:
         1) Krone.
         2) Or equal.

2.9 SERIAL COMMUNICATION CABLE (RS-485)

A. Horizontal Shielded Twisted Pair Cable:
   1. General: Horizontal cabling is the cabling between the Controller and input/output (I/O) systems, serial devices and networks.
   2. Wires: 4 wires. Two tinned copper, polyethylene insulated, twisted pairs with aluminum polyester shield.
   3. Drain: 24AWG stranded tinned copper.
   4. Shield: Overall tinned copper braid.
   5. Jacket: PVC
   6. The cable shall be rated for EIA RS-485 use.
   7. Manufacturer: Provide one of the following:
      a. ATT Plenum LAN Cable 2061.
      b. Belden No. 9842.
      c. Or equal.

2.10 WIRE AND CABLE IDENTIFICATION

A. Color coding of wire and cable jackets shall be per the latest version of the National Electric Code and per accepted trade practices.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and accepted trade practices to prevent damage to the products.
B. Pull all conductors into raceway at same time.
C. No mixing of wire/cable types shall be permitted within the same raceway.
D. AC wire/cable raceways shall be separated from DC signal and communication cable raceways with a minimum separation of 18-inches.
E. Use suitable wire pulling lubricant for wire and cable where necessary.
F. Protect exposed cable from damage.
G. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
I. Clean conductor surfaces before installing connectors.
J. No splices of wire and cable specified under this section will be allowed.
K. Make connections and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify each conductor with its circuit number or other designation indicated on Shop Drawings.

3.5 FIELD QUALITY CONTROL

A. Field inspection, commissioning, and testing will be performed under provisions of Section 16970.
B. Perform operational testing on control systems to verify proper operation and field wiring connections.
C. Inspect wire and cable for physical damage and proper connection.
D. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
E. Verify continuity of each branch circuit conductor.

END OF SECTION

THE CITY OF FLINT, MI

MATERIAL DISPOSAL PLAN (MDP)

This form is to be submitted when removal and off-site disposal of excavation spoils, demolished material or other debris is required from a City of Flint project.

All excavated and demolished material from a construction site that is not to be reused must be properly removed and disposed at an approved facility. If the material is to be disposed of in the City of Flint, a permit or written authorization must be obtained from the City. If it is to be disposed of outside the City limits, documentation must be provided that the Contractor has complied with all the rules and regulations of the local community and that the disposal facility or property owner has given their approval to accept the material. One copy of this form must be completed for each disposal / stockpile site if the Contractor plans to use more than one site. A copy of this plan must be on file with the City and Engineer before initialing construction.

General Project Information and Certification

Date Submitted: City of Flint Project No: _____

Contractor: Project Name: Dort Pump Station Restroation

In submitting this Material Disposal Plan (MDP), the above named contractor expressly certifies that all material to be removed from the construction site will be hauled in accordance with all applicable federal, state, and local highway and traffic rules, regulations and laws, and that the Material Disposal Plan meets all federal, state, and local rules and regulations with regard to the removal and disposal of this material.

Contractor Contact: Title: _____

Signature: Date _____

Disposal of Material within the City of Flint

Is the material to be disposed of within the City of Flint? Yes[1] _____ No _____

[1] Attach a copy of the disposal permit if the above answer is "Yes".

Disposal of Material outside of the City of Flint

Is the material to be disposed of outside of the City of Flint? Yes[2] _____ No _____

[2] Provide the following information if material is to be removed from the site and disposed outside the City of Flint.

Disposal Site: _____ Site Address: _____

Municipality: _____ _____

Is a permit for the above municipality required? Yes[3] _____ No _____

[3] Attach a copy of the municipal permit

Directions to Site _____

_____

Disposal Facility / Property Owner Acknowledgement

I hereby acknowledge that i have agreed to accept material from_____, to be disposed of at our facility / property as described above and that it is my understanding that the above named contractor will meet all federal, state, and local rules and regulations with regard to the removal and transport of this material.

Facility Owner:: _____ Title: _____

Signature: _____ Date _____

REQUIRED STANDARD CONTRACT LANGUAGE: CLEAN WATER STATE REVOLVING FUND AND DRINKING WATER REVOLVING FUND

- Davis-Bacon/Prevailing Federal Wages, Including Labor Standards Provisions
- Disadvantaged Business Enterprise (DBE) Requirements*
- Debarment/Suspension Certification*
- American and Iron Steel Act

* Bidders should note these sections contain instructions regarding forms/information that must be completed/included with any submitted bid.

Rev. 7-2020

Davis-Bacon/Prevailing Federal Wage Rates

P.L. 111-88 requires compliance with the Davis Bacon Act and adherence to the current U.S. Department of Labor Wage Decision. Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Contract Documents (see Wage Decision included herein) must be paid on this project. The Wage Decision, including modifications, must be posted by the Contractor on the job site. A copy of the Federal Labor Standards Provisions is included and is hereby a part of this contract.

"General Decision Number: MI20200083 07/10/2020

Superseded General Decision Number: MI20190083

State: Michigan

Construction Type: Building

County: Genesee County in Michigan.

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

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

Modification Number	Publication Date
0	01/03/2020
1	01/24/2020
2	05/08/2020
3	07/10/2020

* ASBE0047-002 07/01/2020

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 32.52	17.88

BOIL0169-001 03/01/2018

	Rates	Fringes
BOILERMAKER	$ 38.65	26.22

BRMI0009-014 08/01/2019

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

FOOTNOTE:

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

CARP0706-001 06/01/2019

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

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* ELEC0948-001 06/01/2020

	Rates	Fringes
ELECTRICIAN		
Excludes Low Voltage Wiring….	$ 39.17	23.51
Low Voltage Wiring	$ 29.46	17.12

ENGI0324-011 06/01/2019

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

FOOTNOTES:

Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate. Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Backhoe/Excavator/Trackhoe; Bulldozer; Concrete Pump; Crane; Grader/Blade; Highlift; Hoist; Loader; Roller; Scraper; Stiff Leg Derrick; Tractor; Trencher

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

GROUP 5: Boom Truck (non-swinging)

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

GROUP 7: Oiler

IRON0025-019 06/01/2019

	Rates	Fringes
IRONWORKER		
REINFORCING	$ 30.98	27.99
STRUCTURAL	$ 36.77	29.03

LABO0334-005 06/01/2019

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

CLASSIFICATIONS

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

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

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LABO1075-002 06/01/2019

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

PAIN1052-001 06/01/2018

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

PAIN1052-004 06/01/2018

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

PLAS0016-005 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 25.58	12.88

PLUM0370-002 06/01/2018

	Rates	Fringes
PIPEFITTER (Includes HVAC Pipe Installation; Excludes HVAC System Installation)	$ 37.81	20.60
PLUMBER, Excludes HVAC Pipe Installation	$ 37.81	20.60

ROOF0149-005 06/01/2019

	Rates	Fringes
ROOFER	$ 28.53	17.53

SFMI0669-001 04/01/2020

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 35.72	23.60

SHEE0007-008 05/01/2018

	Rates	Fringes
SHEET METAL WORKER, Includes HVAC Duct and Unit Installation	$ 30.64	22.76

SUMI2011-008 02/01/2011

	Rates	Fringes
IRONWORKER, ORNAMENTAL	$ 18.48	7.93
TRUCK DRIVER: Tractor Haul Truck	$ 13.57	1.18

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

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

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

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

Union Rate Identifiers

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

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

Survey Rate Identifiers

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

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

Union Average Rate Identifiers

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

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

WAGE DETERMINATION APPEALS PROCESS

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

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

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

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

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

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

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

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

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

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

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

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END OF GENERAL DECISION"

29 CFR Part 5 - Labor Standards Provisions for Federally Assisted Projects

§ 5.5 Contract provisions and related matters.

(a) The Agency head shall cause or require the contracting officer to insert in full in any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in Sec. 5.1, the following clauses (or any modifications thereof to meet the particular needs of the agency, *Provided,* That such modifications are first approved by the Department of Labor):

(1) *Minimum wages.* (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which ,cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed inthe classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed inthe contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the

contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) *Withholding.* The (write in name of Federal Agency or the Joan or grant recipient) shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) *Payrolls and basic records.* (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described insection 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the (write in name of appropriate

federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted s.hall set out accurately and completely all of the informatio.n required to be maintained under 29 CFR 5'.5(a)(3)(i), except that full social security numbers

and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee *(e.g.,* the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at *http:l lwww.dol.gov/whdlformslwh347.pdf* or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under Sec. 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under Sec. 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the

"Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the (write the name of the agency) or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor. sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records · available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) *Apprentices and trainees--(i) Apprentices.* Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship p Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the jobsite in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits,

apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. in the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) *Trainees.* Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the .wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) *Equal employment opportunity.* The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) *Compliance with Copeland Act requirements.* The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the (write

in the name of the Federal agency) may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) *Contract termination: debarment.* A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) *Compliance with Davis-Bacon and Related Act requirements.* All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) *Disputes concerning labor standards.* Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) *Certification of eligibility.* (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person
or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis- Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) *Contract Work Hours and Safety Standards Act.* The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Sec. 5.5(a) or 4.6 of part'4 of this title. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) *Overtime requirements.* No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work inexcess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times

the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) *Violation; liability for unpaid wages; liquidated damages.* in the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible there for shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) *Withholding for unpaid wages and liquidated damages.* The (write in the name of the Federal agency or the loan or grant recipient) shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b) (1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b) (1) through (4) of this section.

(c) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in Sec. 5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records. to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such

representatives to interview employees during working hours on the job.

Disadvantaged Business Enterprises (DBE)

Prime contractors bidding on this project must follow, document, and maintain documentation of their Good Faith Efforts, as listed below, to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project by increasing DBE awareness of procurement efforts and outreach. Bidders must make the following Good Faith Efforts for any work that will be subcontracted.

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. Place DBEs on solicitation lists and solicit DBEs whenever they are potential sources.

2. Make information on forthcoming opportunities available to DBEs. Arrange time- frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date. The DBEs should be given a minimum of 5 days to respond to the posting.

3. Consider in the contracting process whether firms competing for large contracts can be subcontracted with DBEs. Divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one DBE firm to handle individually.

5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.

Subsequent to compliance with the Good Faith ·Efforts, the following conditions also apply under the DBE requirements. Completed Good Faith Efforts Worksheets (Attachment 1), along with the required supporting documentation outlined in the instructions, must be submitted with your bid proposal. EPA form 6100-2 must also be provided at the pre-bid meeting. A copy of this form is available on the Forms and Guidance page of the Revolving Loan website.

1. The prime contractor must pay its subcontractor for work that has been satisfactorily completed no more than 30 days from the prime contractor's receipt of payment from the owner.

2. The prime contractor must notify the owner inwriting priorto the termination of any DBEsubcontractor forconvenience bythe prime contractor andemploythe Good Faith Efforts ifsoliciting a replacement contractor.

3. If a DBE contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the Good Faith Efforts if soliciting a replacement contractor.

4. The prime contractor must employ the Good Faith Efforts.

Debarment Certification

The prime contractor must provide a completed Certification Regarding Debarment, Suspension,and Other Responsibility Matters Form with its bid or proposal package to the owner (Attachment 2).

Attachment 1

Disadvantaged Business Enterprise (DBE) Utilization

GOOD FAITH EFFORTS WORKSHEET

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

Bidder:_____

Subcontract Area of Work (one per worksheet:_____

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

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

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

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

MITA DBE Posting Date (if applicable):_____
(attachacopyofthe DBEadvertisement)

Other Efforts (attach extra sheets if necessary):

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

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

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

1. Separate worksheets must be provided for each area of work to be subcontracted out. This includes both major and minor subcontracts.

2. A minimum of three (3) DBEs must be contacted by a verifiable means of communication such as e-mail, letter, or fax for each area of work to be subcontracted out. Copies of the solicitation letters/e-mails and fax confirmation sheets must be provided with the worksheet.

3. If less than three (3) DBEs exist statewide for the area of work, then provide documentation that other DBE resources were consulted. This may include the MOOT and www.sam.gov registries and an advertisement is a publication. A printout of the website searched (conducted prior to the end of the bid period) must be submitted.

4. Posting solicitations for quotes/proposals from DBEs on the MITA website (www.mitadbe.com) is highly recommended to facilitate participation in the competitive process whenever possible. The solicitation needs to identify the project and the areas of work to be subcontracted out. A copy of the MITA DBE advertisement must be submitted with the Good Faith Efforts worksheet, if used, or a printout of the resulting quotes posted to the MITA website can be submitted with this form as supporting documentation.

5. If the area of work is so specialized that no DBEs exist, then an explanation is required to support that conclusion, including the documentation required in No. 3 above.

6. The date of the DBE contact must be identified, as it is important to document that the DBE solicitation was made during the bid period and that sufficient time was given for the DBE to return a quote.

7. Each DBE firm's price quote must be identified if one was received or N/A entered on the worksheet if a quote was not received. Copies of all quotes must be submitted with the worksheet.

8. If a quote was received, indicate if it was accepted or rejected. Justification for not accepting a quote and not using the DBE subcontractor must be provided.

9. Under Other Efforts, please indicate additional steps you have taken to obtain DBE contractors and provide the appropriate supporting documentation such as:
   - Follow-up e-mails, faxes, or letters.
   - Copies of announcements/postings in newspapers, trade publications, or minority media that target DBE firms.

Rev. 7-2020

Attachment 2

Certification Regarding

Debarment, Suspension, and Other Responsibility Matters

Certification Regarding

Debarment, Suspension, and Other Responsibility Matters

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

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in transactions under federal non-procurement programs by any federal department or agency;

(2) Have not, within the three year period preceding the proposal, had one or more public transactions (federal, state, or local) terminated for cause or default; and

(3) Are not presently indicted or otherwise criminally or civilly charged by a government entity (federal, state, or local) and have not, within the three year period preceding the proposal, been convicted of or had a civil judgment rendered against it:

(a) For the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public transaction (federal, state, or local) or a procurement contract under such a public transaction;

(b) For the violation of federal or state antitrust statutes, including those proscribing price fixing between competitors, the allocation of customers between competitors, or bid rigging; or

(c) For the commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

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

_____

Name and Title of Authorized Representative

_____

Name of Participant Agency or Firm

_____

Signature of Authorized Representative Date

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

Frequently Asked Questions about Disadvantaged Business Enterprise (DBE) Solicitation

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

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

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

Q: Can non-certified DBEs be used?

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

Q: How does a DBE get certified?

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

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

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

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

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

A: Yes. This is a requirement to document that the contractor has complied with the DBE requirements and the Good Faith Efforts. These compliance efforts must be done during the bidding phase and not after-the-fact. It is highly recommended that the need for these efforts and the submittal of the forms with

the bid proposals be emphasized at the pre-bid meetings. Failure to show that the Good Faith Efforts were complied with during the bidding process can lead to a prime contractor being found non-responsive.

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

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

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

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

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

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

Q: How does a contractor locate certified DBEs?

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

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

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

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

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

Q: If the prime contractor is a DBE, does he have to solicit DBE subcontractors?

A: Yes, the DBE requirements still apply if the prime intends to subcontract work out. Good Faith Efforts must be used to solicit DBEs.

Q: If the area of work is one where there are less than three DBE contractors, how is the contractor to document this?

A: Copies of printouts from MOOT and SAM showing no DBEs and advertisements soliciting quotes for all subcontract areas, including the questionable areas, will be adequate if the dates on the printouts are prior to the bid or proposal closing date.

American Iron and Steel Contract Language

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

United States Environmental Protection Agency

ObtB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/3f/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Partlclpatlon Form

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

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

Contract Item Number	Description of Worh Received from the Prime Contractor Involving Construction, Services , Equipment orSupplies	Amount Received by Prime Contractor

A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as descr.bed in 40 CFR 33.204-33.205 or certff1ed by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as descr:bed In 40 CFR 33.202.

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

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OMB Control No: 2090-0030
Approved: 8/ 13/ 2013
Approval Expires: 8/ 31/ 2015

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

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

Subcontractor 5ignature	Print Name
Title	Date

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