PROJECT MANUAL
FOR THE CONSTRUCTION OF

VILLAGE OF GRAFTON
RIVER BEND ROAD & LIFT STATION

GRAFTON, WISCONSIN

VOLUME 1

AppliedTechnologies
Engineers-Architects

JANUARY 2016

PROJECT MANUAL FOR
THE CONSTRUCTION OF

PROJECT 16-02
RIVER BEND ROAD RESURFACING/LIFT STATION
VILLAGE OF GRAFTON, WISCONSIN

GRAFTON, WISCONSIN

JANUARY 2016

VOLUME 1

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FOR THE
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INVITATION TO BID

Project 16-02
RIVER BEND ROAD RESURFACING / LIFT STATION
VILLAGE OF GRAFTON, WISCONSIN

OWNER: The Village of Grafton hereby gives notice that sealed bids will be received for the construction of the River Bend Road Lift Station.

TIME: Sealed Bids will be received until 11:00 A.M., local time, on Thursday, January 28, 2016, at the Office of the Village Engineer, Municipal Services Facility, 675 North Green Bay Road, Grafton, WI 53024, at which time all bids will be publicly opened and read aloud.

PROJECT: The Work, officially known as "River Bend Road Resurfacing / Lift Station," consists of construction of a new lift station to replace the existing station, including the construction of a new wet well, generator/valve building, sewer and abandonment of the existing lift station. The work also includes construction of an 18-inch interceptor sewer and a 12-inch interceptor sewer to the new lift station, the construction of a force main to the existing force main, and the resurfacing and reconstruction of River Bend Road including the replacement of culvert with 56 feet of 106" by 68" concrete culvert.

BIDDING DOCUMENTS: The Bidding Documents are available for inspection at:

Office of the Village Engineer	Village of Grafton Municipal Services Facility 675 N. Green Bay Road Grafton, WI 53024
Engineer's Office:	Applied Technologies, Inc. 16815 West Wisconsin Avenue Brookfield, Wisconsin 53005 (262) 784-7690 (262) 784-6847 (FAX)

Copies of the Bidding Documents may be obtained from the Village of Grafton website http://www.village.grafton.wi.us under Public Works/Engineering - Project Bids. No paper documents will be provided. Bidding Documents may be downloaded at no charge and will be available on or after January 5, 2016.

PREBID CONFERENCE: None scheduled.

SUBSURFACE INVESTIGATION REPORTS: Included in the Contract Documents.

WAGE RATES: Contractors are required to pay not less than the prevailing wage rates on the project as established by the State of Wisconsin, Department of Workforce Development, Equal Rights Division – Labor Standards Bureau, pursuant to Wisconsin Statutes. Copies of the prevailing wage rate determination will be on file at the addresses listed for inspecting Bidding Documents and will be included in the Contract Documents.

Contractors are also required to conform to the wage requirements prescribed by the federal Davis-Bacon and Related Acts, which requires that all laborers and mechanics employed by contractors and subcontractors performing on projects funded in whole or in part with federal assistance to be paid wages not less than the locally prevailing rates, as determined by the U.S. Department of Labor. Copies of the

federal wage rate determination will be on file at the addresses listed for inspecting Bidding Documents and will be included in the Contract Documents.

OTHER PROVISIONS: The Contract letting shall be subject to the provisions of the Wisconsin Statutes.

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employees or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, 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 and termination; rates of pay or other forms of compensation; selection for training, including apprenticeship. The Contractor further agrees to post in conspicuous places, available for employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

The award of a Contract under this Advertisement for Bids is contingent upon the Owner receiving a loan from the Wisconsin Clean Water Fund. This procurement will be subject to regulations contained in NR162, Wisconsin Administrative Code and appropriate State Statutes. Any contract awarded under this Advertisement for Bids must demonstrate positive efforts to utilize women-owned business enterprises (WBE) and minority-owned business enterprises (MBE). WBE and MBE are encouraged to submit Bid Proposals.

BID SECURITY: Bids shall be accompanied by a certified or bank check or a Bid Bond on the prescribed form payable to the Owner in an amount not less than 5% of the Total Lump Sum Bid as guarantee, that if the Bid is accepted, the Bidder will execute and file the Agreement, Performance and Payment Bonds, and Insurance Certifications, as required by the Contract Documents, within 15 days after the Notice of Award.

BID REJECTION/ACCEPTANCE: The Owner reserves the right to reject any and all Bids, waive any informalities in bidding or to accept the Bid or Bids, which best serve the interests of Owner.

BID WITHDRAWAL: No Bid shall be withdrawn for a period of 90 days after the scheduled opening of the Bids without the consent of the Owner.

Published by authority of the Village of Grafton, Wisconsin.

VILLAGE OF GRAFTON
David Murphy, P.E.
Director of Public Works/Village Engineer

Publish: January 5 & 12, 2016

INSTRUCTIONS TO BIDDERS

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INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS.

1.1. Terms used in these Instructions to Bidders which are defined in the standard General Conditions of the Construction Contract (No. C-700, latest edition) have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Invitation to Bid, Instructions to Bidders, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of bids).

2. COPIES OF BIDDING DOCUMENTS.

2.1. Complete sets of the Bidding Documents may be obtained as stated in the Invitation to Bid.

2.2. Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assume 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 on the Work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS.

3.1. Each Bid must contain evidence of Bidder’s qualification to do business in the state where the project is located or covenant to obtain such qualification prior to award of the Contract.

3.2. All Bidders must be qualified for this specific work. Before a Contract is awarded, the Bidder to whom an award is contemplated may be required to submit the following information to Owner for consideration:

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

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

3.2.3. 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.

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

3.2.5. The Bidder's performance record giving the description, location, and telephone numbers of similar projects constructed in a satisfactory manner by the Bidder.

3.2.6. A list of projects presently under Contract, the approximate Contract amount, and percent of completion of each.

3.2.7. A list of Contracts which resulted in law suits.

3.2.8. A list of Contracts defaulted.

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

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

3.2.11. 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.

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

3.3. The object of the request for the qualification of Bidder is not to discourage bidding or make it difficult for qualified Bidders to file Bids. Neither is it intended to discourage beginning Contractors. It is intended to make it possible for Owner to have exact information on financial ability, equipment, and experience in order to reduce the hazards involved in awarding Contracts to parties who may not be qualified to perform the Work as specified.

3.4. Owner's decision as to qualification of the Bidder shall be final.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE.

4.1. It is the responsibility of each Bidder before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, (c) consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors or discrepancies in the Contract Documents.

4.1.1. A Prebid Conference, if scheduled, will be held as stated in the Invitation to Bid. General (Prime) contract Bidders are required to attend. A tour of the existing site will follow the meeting.

4.2. Reference is made to the Supplementary Conditions for identification of:

4.2.1. Those reports of explorations and tests of subsurface conditions at the site which have been utilized by Engineer in preparation of the Contract Documents. Bidder may rely upon the accuracy of the technical data contained in such reports but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for the purposes of bidding or construction.

4.2.2. Copies of such reports may be examined or obtained as described in the Invitation To Bid. Those reports are not part of the Contract Documents, but the technical data contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.2.1 is incorporated therein by reference.

4.3. Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by

Owners of such Underground Facilities or others, and Owner does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.

4.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Article 4 of the General Conditions.

4.5. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.6. On request in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

4.7. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner, unless otherwise provided in the Contract Documents.

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 Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. INTERPRETATIONS AND ADDENDA.

5.1. All questions about the meaning or intent of the Contract Documents shall be submitted to Engineer in writing not less then 10 days prior to the date for opening of Bids. No response will be provided to a Bidder's oral question if the question involves an interpretation of the intent or meaning of the Contract Documents, or the equality or use of products or methods other than those designated or described in the Contract Documents. Any information provided to Bidders other than by means of the Contract Documents, including Addenda is given informally for information and the convenience of the Bidder only and is without legal effect. The Bidder agrees that such information shall not be used as the basis of, nor shall the giving of any such information entitle the Bidder to assert, any claim or demand against Owner or Engineer on account thereof.

Replies will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Contract Documents.

5.2. Engineer will neither approve nor disapprove materials or equipment prior to the opening of Bids.

5.3. Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer. Addenda will be sent to known Bidders. Addenda become part of the Contract Documents. Include resultant costs in the Bid.

5.4. Each Bidder shall ascertain prior to submitting a Bid that Bidder has received all Addenda issued, and each Bidder shall acknowledge receipt on the Bid Form.

6. BID SECURITY.

6.1. Each Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of the Bidder's Total Base Bid and in the form of a certified or bank check or a Bid Bond on form attached, issued by a surety meeting the requirements of Article 5 of the General Conditions.

6.2. The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within 15 days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the 7th day after the Effective Date of the Agreement, whereupon Bid security furnished by such Bidders will be returned. Bid security of the other Bidders who furnished certified or bank checks and whose Bids are not competitive will be returned within 7 days after the Bid opening. Bond forms of unsuccessful Bidders will be returned upon written request.

7. CONTRACT TIME.

7.1. The numbers of days within, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Bid Form and will be included in the Agreement.

8. LIQUIDATED DAMAGES.

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

9. SUBSTITUTE OR "OR EQUAL" ITEMS.

9.1. The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Article 6 of the General Conditions and may be supplemented in the General Requirements.

9.2. The Contract Documents have been prepared based on the use of certain materials and equipment from specific "named" manufacturers. Naming the manufacturer in the Contract Documents is intended to establish a minimum of the type, function, and quality required. Materials and equipment to be provided by the "named" manufacturers shall comply with all the requirements of the Contract Documents.

9.3. The "named" manufacturers for certain major equipment items are listed in Schedule A - Major Equipment Items, in the Bid Form. Identifying the manufacturer in Schedule A is intended to establish a common basis for all bids to ensure that the Owner receives the full benefit of any savings in cost that may be associated with "or equal" equipment from an alternate manufacturer. All Bidders are required to include all the costs for furnishing the "named" manufacturer identified in Schedule A in the Total Base Bid. No change will be permitted in the selections in Schedule A after the opening of bids unless authorized by OWNER. The Bidder understands that after a contract is awarded, the OWNER may select items of any other manufacturer listed on Schedule. If awarded the contract, the Bidder agrees to provide the owner-selected equipment for the price indicated. The Base Bid amount will then be adjusted accordingly.

9.4. Bidders proposing to offer "or equal" major equipment from an alternate manufacturer must write the alternate manufacturer's name, model number, and the dollar amount for the alternate in the appropriate spaces provided in Schedule A - Major Equipment Items.

9.4.1. If the Bidder proposes "or equal" major equipment he shall incorporate in the price for the alternate all additional costs for and be responsible for layout, piping, plumbing, mechanical, HVAC, structural, instrumentation and control, electrical, and all other changes to the Work required to incorporate the proposed alternate or "or equal" major equipment item(s) into the Work.

9.5. Proposed "or equal" major equipment will only be considered after the Effective Date of the Agreement. The successful Bidder shall submit to the Engineer within 7 days following the Effective Date of the Agreement a proposal containing two sets of drawings, specifications, detailed descriptive material listed below, and any additional materials listed in the specific specifications, for all proposed "or equal" major equipment items. The submittals for all proposed "or equal" major equipment shall be clearly identified by specification section and name of equipment. Failure to comply with these requirements shall be considered appropriate cause for rejection of the "or equal" proposal. No alternate will be considered unless it has been listed in the successful Bidder's Bid Schedule A - Major Equipment Items.

9.5.1. "Or Equal" Major Equipment Submittal Requirements:

9.5.1.1. Complete description of the equipment, system, process or function, including a list of system components, features, dimensional, and weight information for separate components and assemblies, drawings, catalog information and cuts, manufacturer's specifications, including materials description.

9.5.1.2. Performance data and curves, and horsepower requirements.

9.5.1.3. Outside utility requirements for each component, such as water, power, air, etc.

9.5.1.4. Functional description of any internal instrumentation and control supplied including list of parameters monitored, controlled, or alarmed.

9.5.1.5. Addresses and phone numbers of nearest service centers and a listing of the manufacturers or manufacturer's representatives services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.

9.5.1.6. A list of the three most recent installations where similar equipment by the manufacturer or manufacturer's representative is currently in similar service; include contact name, telephone number,

mailing address of the municipality or installation, Engineer, Owner, and installation contractor; if three installations do not exist, the list shall include all that do exist.

9.5.1.7. Detailed information on site, architectural, structural, mechanical, plumbing, HVAC, electrical, process instrumentation and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the Drawings and in the Specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space around the equipment for operation and maintenance, as shown on the Drawings.

9.5.1.8. Other specific submittal requirements listed in the Specifications.

9.5.1.9. All differences between the "named" equipment in the specifications and the proposed "or equal" equipment shall be clearly stated in writing under a heading of "Differences".

9.5.1.10. In submission of substitutions to Products specified, Bidders shall include in their Bid, changes required in the Work to accommodate such approved substitutions. Later claims by the Bidder for an addition to the Contract Time or Contract Price because of changes in Work necessitated by use of substitutions will not be considered

9.6. Within 14 calendar days after receiving all proposed "or equal" major equipment submittals, the Engineer will notify, in writing, the Bidder as to whether or not the submitted proposed substitute or "or equal" major equipment, if any, are accepted by the Owner as meeting the specified requirements. The consideration of this equipment shall not be construed to relieve the successful Bidder and/or Manufacturer/Supplier of the equipment from providing the required construction submittal information.

9.6.1. To be deemed "or equal", the proposed equipment shall be the same or better than the specified named product with respect to features, materials of construction, function, performance, reliability, quality, general dimensional configuration, operation and maintenance costs, operations and maintenance access, and static and dynamic loads. Determination of equality in reference to the project design requirements will be made by the Engineer.

9.6.2. No proposed "or equal" major equipment will be considered unless, in the opinion of the Engineer, it conforms to the Contract Documents in all respects, except for make and manufacturer and minor details.

9.6.3. Requirements of Article 6 of the General Conditions shall be enforced in the evaluation and/or implementation of proposed "or equal" equipment.

9.6.4. Should the proposed "or equal" item be determined "not equal" by the Engineer, then the Bidder shall agree to provide the "named" Manufacturer in Schedule A - Major Equipment Items, for the amount included in his Total Base Bid with NO change in price for that item.

9.6.5. For alternatives accepted by the Owner, the dollar amounts listed in Schedule A - Major Equipment Schedule shall be used to adjust the Total Base Bid Amount to revise the CONTRACT PRICE through a contract modification. The Owner reserves the right to accept or reject any proposed alternative.

10. SUBCONTRACTORS, SUPPLIERS AND OTHERS.

10.1. When required by and in the manner provided on the Bid Form, Bidder shall list and identify those subcontractors, suppliers and other persons and organizations proposed for portions of the Work (including those who are to furnish the principal items of materials and equipment). After the bids are opened but before any award, any Bidder so requested shall submit to Owner such additional listing and identifications as Owner or Engineer may request.

10.2. For additional requirements regarding Subcontractors, Suppliers, and Others, refer to Article 6 of the General Conditions. Refer to the Supplementary Conditions for possible modifications to the paragraphs.

11. BID FORM.

11.1. The Bid Form is included with the Bidding Documents; additional copies may be obtained from the Engineer.

11.2. All blanks on the Bid Form must be completed in black ink or by typewriter. Where requested on the Bid Form, prices must be stated in words and numerals; in case of a conflict, words will take precedence. Bids for alternatives must be included on the Bid Form.

11.3. Bids by corporations must be executed in the corporate name by corporate officer accompanied by evidence of authority to sign and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown where indicated.

11.4. Bids by partnership must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown where indicated.

11.5. All names must be typed or printed below the signature.

11.6. The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which must be listed on the Bid Form.

11.7. The person, address and telephone number for communications regarding the Bid must be shown.

11.8. The Bid price shall include such amounts as the Bidder deems proper for overhead and profit on account of allowances named in the Contract Documents as provided in Article 11 of the General Conditions.

12. SUBMISSION OF BIDS.

12.1. One copy of bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. Any Bids received after the official Bid closure time will be returned to the Bidder unopened.

12.2. Bidders shall be solely responsible for delivery of Bids in manner and time prescribed.

13. MODIFICATION AND WITHDRAWAL OF BIDS.

13.1. Bids may be modified or withdrawn by telegraphic or written communication delivered to the place where Bids are to be submitted at any time prior to the opening of Bids. The telegraphic or written communication should not reveal the bid price but should state the addition or subtraction or other modification so that the final price or terms will not be known by the Owner until the sealed bid is opened.

13.2. Withdrawn Bids may not be resubmitted unless the Work is re-advertised and re-bid upon such advertisement.

14. OPENING OF BIDS.

14.1. Bids will be opened and read aloud publicly. An abstract of the amounts of the Bids will be made available to Bidders after the opening of Bids.

15. BIDS TO REMAIN SUBJECT TO ACCEPTANCE.

15.1. All bids will remain subject to acceptance for the period of time specified in the Invitation to Bid after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

16. AWARD OF CONTRACT.

16.1. Owner reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, nonresponsive, unbalanced or conditional Bids.

16.2. Owner reserves the right to 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, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner.

16.3. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between written amounts and amounts in figures will be resolved in favor of the written amounts.

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

16.5. Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for portions of the Work as to which the identity of Subcontractor, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data are required to be submitted prior to the Notice of Award.

16.6. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

16.6.1. If requested by the Owner, Bidder shall provide a complete breakdown of the Bid, listing separate prices for each Specification Division adding up to the TOTAL BASE BID.

16.7. If the contract is to be awarded, it will be awarded to the lowest, qualified, responsive and responsible Bidder based on the TOTAL BASE BID whose evaluation by Owner indicates that the award will be in the best interests of the Project.

16.8. If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within the period of time specified in the Invitation to Bid after the day of the Bid opening.

17. CONTRACT SECURITY

17.1. Article 5 of the General Conditions and the Supplementary Conditions set forth Owner's requirements as to performance, payment and other Bonds, and insurance requirements. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required performance, payment and other Bonds, and evidence of insurance.

18. SIGNING OF AGREEMENT

18.1. When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by at least 3 unsigned counterparts of the Agreement with all other written Contract Documents attached. Within 15 days thereafter Contractor shall sign and deliver at least 3 counterparts of the Agreement and attached documents to Owner with the required Contract security. Within 10 days thereafter Owner shall deliver one fully signed counterpart to Contractor.

19. SALES AND USE TAXES.

19.1. Bidder shall investigate the statutory requirements for payment of sales and use taxes and if required shall include taxes in the Bid. Refer to Supplementary Conditions Article 6 for additional information.

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

20. WAGE RATES.

20.1. Contractors and subcontractors are required to pay not less than the prevailing wage rates for construction as established by the State of Wisconsin Department of Workforce Development, Equal Rights Division – Labor Standards Bureau, pursuant to Wisconsin Statutes. Contractors and subcontractors are also required to conform to the wage requirements prescribed by the federal Davis-Bacon and Related Acts, which requires that all laborers and mechanics employed by contractors and subcontractors performing on projects funded in whole or in part with federal assistance to be paid wage rates and fringe benefits not less than the locally prevailing rates, as determined by the U.S. Department of Labor. Where the state and federal wage rate determinations differ, the higher of the rates must be paid.

20.2. The Contractor shall comply with all applicable federal, state, and local rules and regulations regarding the posting, certification, and filing of Wage Rates paid to employees. Refer to the Wage Rates section of the Contract Documents.

20.3. The state and federal prevailing Wage Rate determinations for this project are on file with the Owner and/or included in the Contract Documents.

20.4. Bids shall be submitted with a completed Disclosure of Ownership form that is included in the Wage Rates section of the Contract Documents.

21. EQUAL EMPLOYMENT OPPORTUNITY REQUIREMENTS

21.1. 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, developmental disability or national origin as defined in Wisconsin Statutes. 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, a copy of which is included in the Contract Documents.

22. OTHER PROVISIONS

22.1. The Contract letting shall be subject to the provisions of the Wisconsin Statutes.

BID FORM

NOTE: Use Black Ink Or Typewriter For Completing This Bid Form

PROJECT IDENTIFICATION: River Bend Road Resurfacing / Lift Station

THIS BID IS SUBMITTED TO: Village Engineer
Municipal Services Facility
675 North Green Bay Road
Grafton, WI 53024

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. 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 the period of time specified in the Invitation to Bid after the day of Bid opening. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within 15 days after the date of Owner's Notice of Award.

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

(a) Bidder has examined copies of all the Bidding Documents and of the following Addenda, receipt of all which is hereby acknowledged:

Number	Date
_____	_____
_____	_____
_____	_____
_____	_____

(b) Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

(c) Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Article 4 of the General Conditions and accepts the determination set forth in Article 4 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which Bidder is entitled to rely.

(d) Bidder has obtained and carefully studied all such examinations, investigations, explorations, tests and studies which pertain to the subsurface or physical conditions at the site or

otherwise may affect the cost, progress, performance or furnishing of the Work as Bidder considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 4 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by Bidder for such purposes.

(e) Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by Bidder in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 4 of the General Conditions.

(f) Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

(g) Bidder has given Engineer written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Bidder.

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

4. Bidder will complete the Work for the following prices:

UNIT PRICES BID:

The Bidder agrees to accept the following Unit Prices for the items listed. Quantities are not guaranteed. Final payment will be based on actual quantities.

Item No.	Item Description	Unit	Estimated Quantity	Unit Price (Figures)	Extended Amount (Figures)
SECTION 1 – RIVER BEND ROAD RESURFACING					
1	Remove 18” CMP and FES	LF	47		
2	Pulverize and Re-Shape	SY	4,358		
3	Widen Street Sub-Base On North/East Sides	CY	2,310		
4	Estimated Base Repair	Tons	840		

Item No.	Item Description	Unit	Estimated Quantity	Unit Price (Figures)	Extended Amount (Figures)
5	10” Thick Crushed Aggregate Base Course	Tons	1,155		
6	68” X 106” HERCP Class III	LF	76		
7	12” CL V RCP Storm Sewer	LF	129		
8	Storm Inlets	Each	4		
9	Ditch Checks	Each	15		
10	12” Flared End Section	Each	2		
11	Heavy Rip Rap on Type HR Fabric	CY	47		
12	30” Concrete Curb & Gutter	LF	1,817		
13	5” Thick Concrete Sidewalk	SF	9,581		
14	Class A Steel Plate Beam Guard(Incl. EAT’s(4))	LF	398		
15	3” Thick Type E-1 HMA Binder	Tons	1,260		
16	Tack Coat	Gal	368		
17	2” Thick Type E-1 HMA Surface	Tons	840		
18	Detectable Fields for Walk Ramps	Each	2		
19	Asphalt Flumes	Each	1		
20	Modular Block Retaining Wall	SY	593		
21	Seed Mulch and Erosion Mat Disturbed Area	SY	5,565		
22	Furnish & Install Geo-Grid	SY	7,324		
23	Furnish & Install 18” CMP with Apron End Sections	LF	46		
24	Furnish & Install Silt Fence	LF	452		
25	Re-shape and armor bank south of HERCP	Each	1		

Item No.	Item Description	Unit	Estimated Quantity	Unit Price (Figures)	Extended Amount (Figures)
26	Separation fabric for aggregate trail	SY	914		
27	Crushed aggregate trail	Tons	525		
28	Re-construct 17th Street	SY	1,050		
29	Driveway replacement	SY	215		
30	Conc. approach to Lift Sta.	SY	47		
SECTION 2 – RIVER BEND ROAD LIFT STATION FORCE MAIN					
31	Inlet Protection & Erosion Control	LF	3,203		
32	12" AWWA C-900 Force Main, Bedding and Granular Backfill	LF	971		
33	14" HDPE Force Main, directionally drilled	LF	2,168		
34	Air Relief Manhole and force main connection as shown in their respective including excavation, bedding, backfill and pavement restoration	LS	1		
SECTION 3 – BLACKHAWK VALLEY INTERCEPTOR					
35	Furnish & install Silt Fence	LF	1,155		
36	18" PVC Sanitary Sewer, Bedding and Spoil Backfill	LF	1,142		
37	48" Diameter Sanitary Sewer Manholes (4)	VF	66		
38	Topsoil, Seed and Erosion Mat	SY	3,885		
39	Demo exist lift station and manhole, remove pavement, and abandon existing sewers	LS	1		
SECTION 4– RIVER BEND ROAD INTERCEPTOR					
40	Erosion Control	LF	735		
41	12" PVC Sanitary Sewer	LF	1,549		

Item No.	Item Description	Unit	Estimated Quantity	Unit Price (Figures)	Extended Amount (Figures)
42	48” Diameter Sanitary Sewer Manholes (4)	VF	122		
43	Topsoil, seed, and erosion mat	SY	2,625		
SECTION 5 – FALLS SANITARY SEWER					
44	Remove and install sewer line plugs	LS	1		
SECTION 6 – RIVER BEND ROAD LIFT STATION					
45	River Bend Road Lift Station, complete, including all work shown on Group 30 and Group 40	LS	1		
SECTION 7 – ALLOWANCES					
46	Replacement Allowance	LS	1	$5,000	$5,000
47	Skilled Trades Allowance	LS	1	$5,000	$5,000
48	Programming Allowance	LS	1	$5,000	$8,000
49	Utility Allowance	LS	1	$5,000	$10,000
50	Testing and Inspection Allowance	LS	1	$5,000	$10,000

TOTAL BASE BID (Sum of Extended Total Amounts):

The Bidder agrees to complete the Total Base Bid, which is the total of the Unit Prices Bid Sum of Extended Amounts, for the following amount:

_____

(use words)

_____ Dollars $_____._____

(use figures)

If the Contract is to be awarded, it will be awarded to the lowest, qualified, responsive and responsible Bidder based on the TOTAL BASE BID whose evaluation by Owner indicates that the award will be in the best interests of the Project.

5. Bidder agrees that the Work will be substantially completed within 180 days from the date when the Contract Time commences to run as provided in Articles 2 and 14 of the General Conditions, and completed and ready for final payment in accordance with Article 14 of the General Conditions within 240 days from the date when the Contract Time commences to run.

Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work on time.

6. The following documents are attached to and made a condition of this Bid:

(a) Required Bid Security in the form of _____

(b) Schedule A - Major Equipment Schedule

(c) Schedule B - Subcontractor Listing

(d) Statement of the Bidder's qualification to do business in the state where the Project is located; or in the absence of such evidence, this bid constitutes Bidder's covenant to obtain such qualification prior to the award of the Contract.

(e) Disclosure of Ownership form (see Wage Rates).

(f) DBE Program Performance and Utilization Forms (EPA Forms 6100-4)

7. Communications concerning this Bid shall be addressed to:

Name: _____

Company Name: _____

Address: _____

Telephone No.: _____

8. The terms used in this Bid, which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

SUBMITTED ON _____, 20_____

I hereby certify that as Bidder I/We have examined and carefully prepared this Bid from the Bidding Documents and have checked the same in detail before submitting this Bid, and that all statements herein are made on behalf of:

An Individual

By (Individual's Signature) _____ (SEAL)

Individual's Name (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

A Partnership

By (Firm Name) _____ (SEAL)

Signature of General Partner _____

Name of General Partner (Print) _____

Business Address: _____

_____

_____

Phone No.: _____

A Corporation

By (Corporation Name) _____

State of Incorporation _____

Signature of Authorized Representative _____

Name of Authorized Rep. (Print) _____

Title _____ (SEAL)

Attest (Signature) _____

Name of Attester (Print) _____

Business address: _____

_____

_____

Phone No.: _____

A Joint Venture

By (Representative's Signature) _____ (SEAL)

Representative's Name & Title (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

By (Representative's Signature) _____ (SEAL)

Representative's Name & Title (Print) _____

Doing business as (Firm Name) _____

Business address: _____

_____

_____

Phone No.: _____

(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).

Sworn and subscribed to before me this

_____ day of _____, 20_____.

_____

Notary or Other Officer Authorized To
Administer Oaths

My commission expires: _____

SCHEDULE A MAJOR EQUIPMENT SCHEDULE					
Specification Section	Equipment Description	Named Manufacturers and Suppliers Included in Base Bid **(Circle the One Selected)**	Dollar Amount Included in Base Bid to Furnish Equipment/material **(Use Figures for the Selected One)**	Alternate ("Or Equal") Manufacturers and Suppliers (Fill in names)	Dollar Amount To Be Deducted From Base Bid if Alternative ("Or Equal") Is Chosen (Use Figures)
11316	Submersible Pumps	A. Flygt Xylem	A. …….	B. ……	B. ……
13320	General Instrumentation and Controls	A. KAMP/Synergy/ Energenecs B. Starnet	A. ……. B. ……..	A. ……. B. ……..	C. ……
16483	Adjustable Speed Controllers	A. Allen-Bradley B. Siemens C. Square-D	A. ……. B. …….. C. ……..	D. ……	D. ……
16620	Standby Power Generator	A. Kohler Co B. Cummins Onan	A. ……. B. ……..	C. ……	C. ……

SCHEDULE B
SUBCONTRACTOR LISTING

The Bidder certifies that the following firms or businesses will be awarded subcontracts for the indicated portions of the Work in the event that the Bidder is awarded the Contract. In addition to the subcontractors listed, fill in the names of all other subcontractors and suppliers whose contract amounts equal or exceeds 10% of the Total Base Bid Amount. The Bidder agrees that, after the opening of Bids, no changes or substitutions in the listing will be allowed without the written approval of the Owner. Requests for such changes or substitutions shall be made in writing with appropriate documentation and reasons included. If space is inadequate, attach additional sheets with identical information.

Mechanical Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Electrical Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Heating, Ventilating, & Air Conditioning Subcontractor

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

Other

Name of Firm: _____

Type of Work: _____

Address: _____
Street City State (Zip)

$ Amount _____

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that _____

_____

hereinafter called the Principal (Bidder), and _____

a corporation duly organized and existing under the laws of the State of _____,

having its principal place of business at _____, and authorized to do business in the State of Wisconsin, as Surety, are held and firmly bound unto the _____

_____

_____

hereinafter called the Obligee, in the penal sum of _____

_____ DOLLARS

($_____) for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the Principal is herewith submitting his or its Bid for:

_____

_____

_____

said Bid, by reference thereto, being hereby made a part hereof.

NOW, THEREFORE, if the Bid submitted by the Principal is accepted, and the Contract awarded to the Principal, and if the Principal shall execute the proposed Agreement and shall furnish such Performance Bond and Payment Bond as required by the Contract Documents within the time fixed by the Documents, then this obligation shall be void; if the Principal shall fail to execute the proposed Agreement and furnish the bonds, the Surety hereby agrees to pay to the Obligee the penal sum as liquidated damages.

Signed and sealed this _____ day of _____, 20_____.

[SEAL] _____

PRINCIPAL

_____ _____

WITNESS BY (TITLE)

[SEAL] _____

SURETY

_____ _____

WITNESS BY (TITLE)

AGREEMENT

THIS AGREEMENT is dated as of the _____ day of _____ in the year_____ by and between the Village of Grafton (hereinafter called Owner) and _____ (hereinafter called Contractor).

Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK

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

Furnish and install, complete, all labor, materials, equipment, tools, power, utilities, transportation, and all other items and services to perform construction of the complete project.

ARTICLE 2. THE PROJECT

2.01 The Project is generally described as follows:

The Work, officially known as "River Bend Road Resurfacing / Lift Station," consists of construction of a new lift station to replace the existing station, including the construction of a new wet well, generator/valve building, sewer and abandonment of the existing lift station. The work also includes construction of an 18-inch interceptor sewer and a 12-inch interceptor sewer to the new lift station, the construction of a force main to the existing force main, and the resurfacing and reconstruction of River Bend Road including the replacement of culvert with 56 feet of 106" by 68" concrete culvert.

ARTICLE 3. ENGINEER

3.01 The project has been designed by Applied Technologies, Inc. who is hereinafter called Engineer and who 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 completion of the Work in accordance with the Contract Documents.

ARTICLE 4. CONTRACT TIMES

4.01 The Work will be substantially completed within 180 days from the date when the Contract Time commences to run as provided in Articles 2 and 14 of the General Conditions, and completed and ready for final payment in accordance with Article 14 of the General Conditions within 210 days from the date when the Contract Time commences to run.

4.02 Liquidated Damages.

A. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not 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 Two Hundred and 00/100 Dollars ($200.00) for each day that expires after the time specified above for Substantial Completion until the Work is 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 One Hundred and 00/100 Dollars ($100.00) for each day that expires after the time specified above for completion and readiness for final payment.

ARTICLE 5. CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds as follows:

TOTAL BASE BID: _____

All specific cash allowances are included in the above price and have been computed in accordance with Article 11 of the General Conditions.

ARTICLE 6. PAYMENT PROCEDURES

6.01 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.

6.02 Progress Payments.

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, once each month during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Article 2 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.

B. Prior to substantial completion, after each Application for Payment has been found acceptable by Owner, Owner will pay 95% of the estimated value less any previous payments to Contractor until the Project is 50% complete. At 50% completion, further partial payment shall be made in full to Contractor and no additional amounts may be retained unless Engineer certifies that the job is not proceeding satisfactorily, but amounts previously retained shall not be paid to Contractor. At 50% completion or any time thereafter when the progress of the Work is not satisfactory, additional amounts may

be retained but in no event shall the total retainage be more than 10% of the value of the Work completed.

C. Upon substantial completion of the Work, an amount retained may be paid to the Contractor. When the work has been substantially completed except for Work which cannot be completed because of weather conditions, lack of materials or other reasons which in the judgment of the Owner are valid reasons for non-completion, the Owner may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the Work still to be completed or in the alternative may pay out the entire amount retained and receive from the Contractor guarantees in the form of a bond or other collateral sufficient to ensure completion of the job.

6.03 Final Payment.

A. Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Article 14.

ARTICLE 7. INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the maximum rate allowed by law at the place of the Project.

ARTICLE 8. CONTRACTOR'S REPRESENTATIONS

8.01 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 in any manner may affect cost, progress, performance or furnishing of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local laws and regulations that may in any manner may affect cost, progress, performance or furnishing of the Work.

D. Contractor has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Article 4 of the General Conditions, and accepts the determinations set forth in Article 4 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which Contractor is entitled to rely.

E. Contractor has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the

cost, progress, performance or furnishing of the Work as Contractor considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 4 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by Contractor for such purposes.

F. Contractor has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by Contractor in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Article 4 of the General Conditions.

G. Contractor has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

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

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

ARTICLE 9. CONTRACT DOCUMENTS

9.01 The Contract Documents, which comprise the entire agreement between Owner and Contractor concerning the Work, consist of the following:

A. This Agreement (pages 00505-1 to 00505-6, inclusive).

B. Exhibits to this Agreement (pages _____ to _____, inclusive).

C. Performance and Payment Bonds, identified as exhibits 00610 and 00615 and consisting of four (4) pages.

D. Notice of Award (not attached).

E. General Conditions (pages 700-1 to 700-48, inclusive, not attached).

F. Supplementary Conditions (pages 00815-1 to 00815-15, inclusive, not attached).

G. Specifications consisting of Divisions and pages listed in Table of Contents of the Project Manual (not attached).

H. Drawings, consisting of sheets numbered 10-G-1 through 99-E-1 , inclusive, (not attached) with each sheet dated, Jan 2016 bearing the following general title:

RIVER BEND ROAD & LIFT STATION
VILLAGE OF GRAFTON, WISCONSIN

I. Addenda numbers _____ to _____, inclusive (not attached).

J. Instructions to Bidders (pages 00200-1 to 00200-11 , inclusive, not attached).

K. Contractor's Bid (pages 00410-1 to 00410-11 including Schedules: A and B , inclusive).

L. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive).

M. The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Article 3 of the General Conditions.

9.02 The documents listed in paragraphs 9.01.A et seq. above are attached to this Agreement (except as expressly noted otherwise above).

9.03 There are no Contract Documents other than those listed in this Article 9. The Contract Documents may only be amended, modified or supplemented as provided in Article 3 of the General Conditions.

ARTICLE 10. MISCELLANEOUS

10.01 Terms used in this Agreement will have the meanings indicated in the General Conditions.

10.02 No assignment by a party hereto of any rights under or interests in the Contract Documents 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.

10.03 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.

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

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate. One counterpart each has been delivered to Owner, Contractor and Engineer. All portions of the Contract Documents have been signed or identified by Owner and Contractor.

This Agreement will be effective on _____ .

Owner _____

By _____
[SEAL]

Attest _____

Address for giving notices

_____

_____

_____

Contractor_____

By _____
[SEAL]

Attest _____

Address for giving notices

_____

_____

_____

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

License No. _____
(where applicable)

Agent for service of process: _____

_____
(If Contractor is a corporation, attach evidence of authority to sign.)

Designated Representative:

Name: _____

Title: _____

Address: _____

Phone: _____

Facsimile: _____

Email: _____

Designated Representative:

Name: _____

Title: _____

Address: _____

Phone: _____

Facsimile: _____

Email: _____

PERFORMANCE BOND

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

CONTRACTOR (Name and Address):

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

OWNER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-610 (2002 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, and the American Institute of Architects.

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

2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 3.1.

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

3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and

3.3. Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract;

2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

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

4.1. Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or

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

4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or

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

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

2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of Surety under Paragraph 4; and

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

7. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the 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 Owner or its heirs, executors, administrators, or successors.

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

9. 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 Contractor Default or within two years after Contractor ceased working or within two years after 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 period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

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

12. Definitions.

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

12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3. Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

12.4. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker
Owner’s Respresentative (engineer or other party)

PAYMENT BOND

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

CONTRACTOR (Name and Address):

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

OWNER (Name and Address):

CONTRACT
Date:
Amount:
Description (Name and Location):

BOND
Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-615 (2002 Edition)
Originally prepared through the joint efforts of the Surety Association of America, Engineers Joint Contract Documents Committee, the Associated General Contractors of America, the American Institute of Architects, the American Subcontractors Association, and the Associated Specialty Contractors.

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

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2. Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and

2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and

3. Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

6.1. Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2. Pay or arrange for payment of any undisputed amounts.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

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

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

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

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, 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.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

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

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1. Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and 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.

15.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone
Surety Agency or Broker:
Owner's Representative (engineer or other party):

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

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Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

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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).

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STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *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.

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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 is 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.

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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.

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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.

1.02 *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.

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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

2.01 *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.

2.02 *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.

2.03 *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.

2.04 *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.

2.05 *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.

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2.06 *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.

2.07 *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

3.01 *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.

3.02 *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.

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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.

3.03 *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 thereby.

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).

3.04 *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.

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3.05 *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.

3.06 *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

4.01 *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.

4.02 *Subsurface and Physical Conditions*

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

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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.

4.03 *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 rely as 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.

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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.

4.04 *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.

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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 or 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.

4.05 *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.

4.06 *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)

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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

5.01 *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.

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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 5.01.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 5.01.B and 5.02.

5.02 *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.

5.03 *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.

5.04 *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;

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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.

5.05 *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.

5.06 *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;

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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.

5.07 *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

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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.

5.08 *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.

5.09 *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.

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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

6.01 *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.

6.02 *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.

6.03 *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.

6.04 *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.

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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.

6.05 *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:

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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 6.05.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 6.05.A and 6.05.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.

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

6.06 *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 6.06.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.

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6.07 *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.

6.08 *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.

6.09 *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.

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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:

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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.

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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:*

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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;

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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.

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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

7.01 *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.

7.02 *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.

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7.03 *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

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *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.

8.05 *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.

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *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

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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

9.01 *Owner's Representative*

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

9.02 *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.

9.03 *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.

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9.04 *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.

9.05 *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.

9.06 *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.

9.07 *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 10.05.

9.08 *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 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, 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.

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9.09 *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 14.07.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 9.09 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

10.01 *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 10.05.

10.02 *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 13.04.D.

10.03 *Execution of Change Orders*

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

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1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.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 10.05; 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.

10.04 *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.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, 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 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.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 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.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.

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F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

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

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.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 11.01.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 11.01.

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

5. Supplemental costs including the following:

   a. 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

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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 11.01.A.1 or specifically covered by Paragraph 11.01.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 11.01.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 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted

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accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

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

B. *Cash Allowances:*

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.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the 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 9.07.

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 10.05 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.

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

12.01 *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 10.05.

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 11.03); 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 12.01.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 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.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 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.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 12.01.C.2.a and 12.01.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 11.01.A.1 and 11.01.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 11.01.A.4, 11.01.A.5, and 11.01.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 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *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 10.05.

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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.

12.03 *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 12.02.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 12.03.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

13.01 *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.

13.02 *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.

13.03 *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.

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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 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.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 13.03.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.

13.04 *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 10.05.

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 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to 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

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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.

13.06 *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 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *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 13.07, 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 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

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13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, 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 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.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 13.09, 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 the rights 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 13.09 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 10.05. 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 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.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.

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14.02 *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 9.07, 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

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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 14.02.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 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.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 14.02.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 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.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 14.02.C.1 and subject to interest as provided in the Agreement.

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14.03 *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.

14.04 *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.

14.05 *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 14.04.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

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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 14.04 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.

14.06 *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.

14.07 *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 5.04.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 14.07.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 14.09. 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.

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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.

14.08 *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 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *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 14.06, 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

15.01 *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 10.05.

15.02 *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 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

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.

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B. If one or more of the events identified in Paragraph 15.02.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 15.02.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 15.02.B and 15.02.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 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *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.

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15.04 *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 15.03.

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 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 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

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.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 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.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

17.01 *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.

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17.02 *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.

17.03 *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.

17.04 *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.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the General Conditions of the Construction Contract (EJCDC No. C-700, latest Edition) and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

The terms used in these Supplementary Conditions, which are defined in the Standard General Conditions of the Construction Contract, have the meanings assigned to them in the General Conditions.

Delete the definitions of "Contract Documents" and insert the following in its place:

Contract Documents - those documents identified in Article 8 of the Agreement.

Amend the definition entitled "Engineer" by adding the following language:

Whenever the word Architect or Architect/Engineer is used in the Specifications, it shall have the same meaning as the word Engineer as defined in this definition.

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.01 Delete Paragraph 2.01.B. of the General Conditions in its entirety and replace with the following:

2.01.B. When Contractor delivers the executed Agreement to Owner, Contractor shall also 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 Article 5 in the General Conditions. Before commencement of Contract Time, Owner shall deliver to Contractor certificates of insurance (and other evidence of insurance requested by Contractor) which Owner is required to purchase and maintain in accordance with Article 5 in the General Conditions.

SC-2.02. Delete Paragraph 2.02 of the General Conditions in its entirety and insert the following in its place:

2.02 Additional copies of the Drawings and Project Manual will be furnished upon request at the cost of reproduction.

SC-2.03. Delete Paragraph 2.03 of the General Conditions in its entirety and insert the following in its place:

2.03 The Contract Time will commence to run on the effective date of the Agreement.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

SC-4.02 Add the following language at the end of paragraph 4.02.A of the General Conditions:

The following reports of Explorations and tests of subsurface conditions at the site of work:

Pavement Exploration Service Report
Proposed Road Reconstruction, and Lift Station, Utility, and Culvert Construction
River Bend Road and 17th Avenue
Village of Grafton, Wisconsin
Prepared By: Professional Service Industries, Inc.
October 1, 2015
PSI Report No.: 00521331

Copies of the Reports are included with Bidding Documents. These reports are not part of the Contract Documents, but the technical data contained therein upon which Contractor is entitled to rely as provided in Article 4 of the General Conditions are incorporated therein by reference.

ARTICLE 5 - BONDS AND INSURANCE

SC-5.01. Add the following language at the end of paragraph 5.01.B of the General Conditions:

The prescribed forms for the Performance and Payments Bonds are included in the Contract Documents.

SC-5.04. The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

5.04.A.1. and 5.04.A.2. Workers' Compensation, etc. under paragraphs 5.04.A.1 and 5.04.A.2 of the General Conditions:

(1) Workmen's compensation (Including coverage under United States Longshoremen's and Harbor Workers Act, where applicable) Statutory

(2) Employer's Liability

Each Accident	$100,000
Disease; Each Employee	$100,000
Disease; Aggregate	$500,000

5.04.A.3, 5.04.A.4 and 5.04.A.5. Commercial General Liability under paragraphs 5.04A.3 through 5.04A.5 of the General Conditions:

(3) Coverage to include premises operations, product and completed operations, and the explosion (x), collapse (c), and underground property damage (u) hazard exposures, all subject to the following limits:

Each Occurrence – Bodily Injury and Property Damage	$5,000,000

Personal Injury	$5,000,000
Products – Completed Operation Aggregate	$5,000,000
General Aggregate	$5,000,000

5.04.A.6. Automobile Liability under paragraphs 5.04.A6 of the General Conditions:

Automobile Liability coverage to include operations of owned, hired, and non-owned motor vehicles, all subject to a combined single limit of not less than $5,000,000 per occurrence for bodily injury and property damage.

5.04.A.3, 5.04.A.4 and 5.04.A.5. and 5.04.A.6 Commercial General Liability and Automobile Liability under paragraphs 5.04.A.3 through 5.04.A.6 of the General Conditions:

Liability insurance may be arranged by Commercial General Liability and Automobile Liability policies for the full limits required, or by a combination of underlying policies for the lesser limits with the remaining limits provided by an Excess or umbrella policy.

SC-5.05. Owner's Liability Insurance:

Delete paragraph 5.05 of the General Conditions in its entirety and insert the following in its place:

5.05.A. The Contractor shall include the Owner and its subsidiaries and the Engineer by endorsement as additional insureds under the Contractor's General Liability Policy and Umbrella Liability Policies.

SC-5.06. Delete paragraph 5.06 of the General Conditions in its entirety and insert the following in its place:

5.06.A. CONTRACTOR shall purchase and maintain until final payment property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in these Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and Engineer's consultants in the Work (all of whom shall be listed as insureds or additional insured parties), shall insure against the perils of fire and extended coverage, shall include "all-risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in these Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all-risk" insurance or otherwise provided in these Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment. The policies of insurance to be purchased and maintained by CONTRACTOR in accordance with this

paragraph 5.06.A shall comply with the requirements of paragraph 5.04 of the General Conditions.

SC-5.07. In paragraph 5.07.A. of the General Conditions, replace the opening words to the third sentence "Owner and Contractor waive all rights against each other" with "Contractor waives all rights against Owner".

Delete paragraphs 5.07.B and 5.07.C of the General Condition in their entirety.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

SC-6.06 Add a new paragraph immediately after paragraph 6.06.B of the General Conditions which is to read as follows:

6.06.B.1. Schedule B - Subcontractor Listing, shall be completed and included with the Bid Form at the time of Bid Opening.

Within seven (7) days following Bid Opening and before Notice of Award, the apparent successful bidder shall, in addition to Schedule B, provide a listing that identifies all subcontractors, suppliers, and manufacturers, that are to provide labor and/or materials with an aggregate value greater than or equal to $20,000. Subsequent to submittal of this listing, Bidder shall not make any changes or substitutions to the listing.

SC-6.10 Add the following language at the end of paragraph 6.10 of the General Conditions:

Contractor shall refer to and comply with the stipulations set forth in Wisconsin Administrative Rules regarding Wisconsin Sales and Use Tax Exemption in order to obtain a state sales tax exemption on the purchase of certain items (see Attached Exhibit A). Tangible personal property that becomes a component of a facility in this state that is owned by a county, municipality, school district, or nonprofit organization is exempt from Wisconsin sales and use tax. Refer to the attached Exemption Certificate (Wisconsin Department of Revenue Form S-211) for instructions to claim exemption.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-9.03. Add the following language at the end of paragraph 9.03 of the General Conditions:

9.03.A.1 Engineer may furnish a Resident Project Representative (RPR), assistants, and other field staff to assist Engineer in observing performance of the work of the Contractor. The duties, responsibilities, and limitations of authority of any such Resident Project Representative and assistants will be as provided in Exhibit B in these Supplementary Conditions.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

SC-10.05. Amend the first sentence of paragraph 10.05.A of the General Conditions by deleting the words "30 days" and inserting the words "10 days" in their place, amend the second sentence in paragraph 10.05.A of the General Conditions by deleting the words "60 days" and inserting the words "30 days" in their place, and as so amended paragraph 10.05.A remains in effect.

ARTICLE 13 - TESTS AND INSPECTIONS

SC-13.02. Add the following paragraph:

In accordance with NR 162.10(4), Contractor shall provide proper facilities for access to, and inspection of, the Work by representatives of the Wisconsin Department of Natural Resources (WDNR). The Contractor shall allow the WDNR or any of its authorized representatives to have access to any books, documents, plans, reports, papers and other records which are pertinent to the Work for the purpose of making audits, inspections, examinations, excerpts, copies and transcriptions. The Contractor shall ensure that all parties to subagreements will provide the WDNR access to the project, including sites, documents, and records.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

SC-14.02. Amend the first sentence of paragraph 14.02.A.1 of the General Conditions by striking out the words "20 days" and inserting the words "40 days" in their place, and as so amended, paragraph 14.02.A.1 remains in effect.

Amend the last sentence of paragraph 14.02.C.1 of the General Conditions by striking out the words "Ten days" and inserting the words "Thirty days" in their place, and as so amended, paragraph 14.02.C.1 remains in effect.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

SC-15.04. Amend the first sentence in paragraph 15.04.A of the General Conditions by striking out the words "30 days" in two places and inserting the words "60 days" in their place, and as so amended paragraph 15.04.A remains in effect.

ARTICLE 17 - MISCELLANEOUS

Add the following new paragraphs to Article 17 of the General Conditions:

SC-17.07. Lien Waivers

17.07.A Owner may require at any time during the Work, as well as at Substantial Completion of the Work, that Contractor furnish lien waivers for labor and materials used.

SC-17.08. Wage Rates

17.08.1 Contractors shall comply with the minimum wage rate for laborers and mechanics as determined by the Secretary of Labor in accordance with the provisions of the Davis-Bacon and Related Acts including 29 CRF Part 5.5a, and wage rates for construction as established by the State of Wisconsin Department of Workforce Development, Equal Rights Division – Labor Standards Bureau, pursuant to Wisconsin Statutes.

17.08.2 The Contractor shall comply with all applicable federal, state, and local rules and regulations regarding the posting, certification, and filing of Wage Rates paid to employees.

17.08.3 A prevailing Wage Rate determination for this project is on file with the Owner and/or included in the Project Manual.

SC-17.09. Equal Employment Opportunity Requirements

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, developmental disability or national origin as defined in s. 51.01(5), Wisconsin Statutes. 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, a copy of which is included in the Project Manual.

Exhibit A
2015 Assembly Bill 313 and Senate Bill 227 – Signed by Governor 12-16-2015
Wisconsin Administrative Rule Tax 11

Tax 11.11 Utility, industrial and governmental waste treatment facilities. (1) GENERAL Section 77.54 (26), Stats., provides a sales and use tax exemption for tangible personal property and items and property under s. 77.52 (1) (b) and (c), Stats., which becomes a component part of certain waste treatment facilities.

(2) UTILITY WASTE TREATMENT EXEMPTION. If a utility waste treatment facility that is taxed under ch. 76, Stats., qualifies for property tax exemption under s. 76.025 (1), Stats., as approved by the department, it qualifies for the sales and use tax exemption under s. 77.54 (26), Stats.

Note: Refer to s. Tax 6.40 for information on how to request approvals for property tax exemption for utility waste treatment facilities. For more information regarding exemptions for waste treatment facilities owned by a utility, including railroads, airlines, and pipelines, approved by the department, write to Wisconsin Department of Revenue, Manufacturing and Utility Section, PO Box 8971, Madison WI 53708-8971; telephone (608) 266-8162; send an e-mail to utility@revenue.wi.gov; or access the department's internet web site at http://www.revenue.wi.gov/contact/slfbmta.html.

(2m) INDUSTRIAL WASTE TREATMENT EXEMPTION. (a) An industrial waste treatment facility is any property purchased or constructed as a waste treatment facility used exclusively and directly to remove, store, or cause a physical or chemical change in industrial waste or air contaminants for the purpose of abating or eliminating pollution of surface waters, the air, or waters of the state if that property is not used to grow agricultural products for sale. In this paragraph, "used exclusively" means to the exclusion of all other uses except:

1. For other use not exceeding 5% of total use.

2. To produce heat or steam for a manufacturing process, if the fuel consists of either 95% or more industrial waste that would otherwise be considered superfluous, discarded, or fugitive material or 50 percent or more of wood chips, sawdust, or other wood residue from the paper and wood products manufacturing process, if the wood chips, sawdust, or other wood residue would otherwise be considered superfluous, discarded, or fugitive material.

(b) Tangible personal property and items and property under s. 77.52 (1) (b) and (c), Stats., becoming a component part of an industrial waste treatment facility is exempt from the sales and use tax under s. 77.54 (26), Stats., if the facility qualifies for property tax exemption under s. 70.11 (21), Stats.

Note: Refer to s. Tax 12.40 for information related to the property tax exemption for industrial waste treatment facilities. For more information regarding the property tax exemption for industrial waste treatment facilities of manufacturers write or call the district office of the Wisconsin Department of Revenue, Bureau of Manufacturing and Telco Assessments. To locate the district office, write or call Wisconsin Department of Revenue, Bureau of Manufacturing and Telco Assessment, PO Box 8971, Madison WI 53708-8971; telephone (608) 266-1147. The web site is www.revenue.wi.gov/contact/slfbmta.html. To ascertain whether a non-manufacturing property would be exempt under s. 70.11(21), Stats., owners may refer to the Wisconsin Property Assessment Manual or contact the local property tax assessor.

(3) MUNICIPAL WASTE TREATMENT EXEMPTION. Tangible personal property and items and property under s. 77.52 (1) (b) and (c), Stats., which become a component or ingredient part of the following municipal facilities that treat waste qualifies for exemption from Wisconsin sales and use tax under s. 77.54 (26), Stats.:

(a) *Wastewater treatment facility.* 1. Only the central waste treatment plant which actually treats the sewage qualifies for the exemption.

2. Storm sewers, water supply systems and private domestic waste water facilities do not qualify for the sales and use tax exemption.

3. The collection system throughout the area served by the treatment facility, the effluent pipeline carrying the treated sewage away from the central treatment plant, earthen dikes, and chain link fences on the boundary of a treatment plant, and dredge material disposal sites are not exempt. The collection systems includes the lift stations, force mains, and associated pumping equipment used to bring the raw sewage to the central treatment plant.

(b) *Material recovery facility.* 1. A facility constructed by a municipality to meet mandates of ch. 287, Stats., regarding the reuse, recycling, and recovery of waste material to reduce the need for waste disposal is exempt if the activities include all of the following:

a. Sorting recyclable materials delivered from municipalities.

b. Processing recyclable materials which may include removing contaminants, baling paper, shredding paper, pelletizing plastics, and crushing glass.

c. Storing processed recyclable materials for sale to others.

2. The exemption does not apply if the only activities performed are sorting and storing and no processing of the materials takes place.

(c) *Sanitary landfill.* A sanitary landfill, including the treatment equipment, such as the collection and burner system, laboratory equipment, maintenance buildings, garages, office buildings, fences, and gates, qualifies for exemption.

(d) *Groundwater facilities.* 1. A municipal facility constructed to treat hazardous or contaminated groundwater, including oil and water separators, air strippers, aerators, blowers, filters, carbon units, controls, pumps, and thermal oxidizers, qualifies for exemption.

2. The collection system used to bring the hazardous or contaminated water to the facility and the distribution system used to carry the treated water away from the facility are not exempt.

Note: For more information regarding the exemption for municipal treatment facilities, write or call Wisconsin Department of Revenue, Bureau of Customer Service, Mail Stop 5-77, PO Box 8902, Madison WI 53708-8902, telephone (608) 266-2772. The web site is www.revenue.wi.gov.

(4) REPAIR, SERVICE AND OPERATION. (a) The repair, service, alteration, cleaning, painting, and maintenance of a utility waste treatment facility described in sub. (2), an industrial waste treatment facility described in sub. (2m), and a municipal waste treatment facility described in sub. (3) as well as the repair parts and replacement for those types of facilities are exempt from the sales and use tax.

(b) Chemicals and supplies, including fuel and electricity, used or consumed in operating a utility waste treatment facility described in sub. (2), an industrial waste treatment facility described in sub. (2m) and a municipal waste treatment facility described in sub. (3) are exempt from the sales and use tax.

(5) Contractors and subcontractors. (a) *Exempt purchases*. The sales and use tax exemption extends to and includes the purchases of tangible personal property and items and property under s. 77.52 (1) (b) and (c), Stats., by a contractor-installer who incorporates the property into an approved utility waste treatment facility or who incorporates the property into an industrial waste treatment facility or a municipal waste treatment facility. The contractor-installer shall certify the intended exempt use of the item to each supplier in order to relieve the supplier of the duty of collecting and reporting the tax on the sales. Certification of exempt use shall be made on a Wisconsin sales and use tax exemption certificate, form S-211.

Note: Form S-211 may be obtained by writing or calling Wisconsin Department of Revenue, P.O. Box 8902, Madison, WI 53708-8902, telephone (608) 266-2776.

(b) *Taxable purchases*. A contractor's purchases of items used or consumed in the performance of the construction contract, and which do not become a component part of the waste treatment facility, are subject to the tax. This includes industrial gases, form lumber, tunnel shields, and supplies used by a contractor during construction. Payments by a contractor for equipment purchased or leased to perform a construction job are also taxable.

(c) *Determining exemptions*. 1. `Utility property taxed under ch. 76, Stats.' A contractor or subcontractor may be liable for sales and use tax on a purchase of tangible personal property or items or property under s. 77.52 (1) (b) or (c), Stats., that becomes a component part of a utility waste treatment facility that has not been approved by the department for a property tax exemption under s. 76.025 (1), Stats.

Note: Contractors may direct questions concerning the property to the department as provided in sub. (2).

2. `Industrial property taxed under ch. 70, Stats.' Approvals are not required for industrial waste treatment facilities. A contractor or subcontractor may be liable for sales and use tax on a purchase of tangible personal property or items or property under s. 77.52 (1) (b) or (c), Stats., that becomes a component part of a facility that is determined to not qualify for a waste treatment facility property tax exemption under s. 70.11 (21), Stats.

Note: Contractors may direct questions concerning the taxability of the waste treatment facility to the department as provided in sub. (2m).

3. `Municipal waste treatment facilities.' Approvals are not required for municipal waste treatment facilities. A contractor or subcontractor may be liable for sales and use tax on a purchase of tangible personal property or items or property under s. 77.52 (1) (b) or (c), Stats., that becomes a component part of a facility that is determined not to be a municipal waste treatment facility as provided in sub. (3).

Note: Contractors may direct questions concerning the taxability of the waste treatment facility to the department as provided in sub. (2m).

Note: Section Tax 11.11 interprets s. 77.54 (26), Stats.

Note: The interpretations in s. Tax 11.11 are effective July 31, 1975 when ss. 70.11 (21) and 77.54 (26), Stats., were revised, except: (a) The exemptions for chemicals and supplies used or consumed in operating a waste treatment facility became effective September 1, 1979, pursuant to Chapter 39, Laws of 1979; (b) The approval process for property and sales tax exemptions for industrial waste treatment facilities, except utilities, were eliminated effective January 1, 2002, pursuant to 2001 Wis. Act 16; (c) The definition of an industrial waste treatment facility was amended pursuant to 2007 Wis. Act 19 and applies on and after October 1, 2007; and (d) The separate impositions of tax on coins and stamps sold above face value under s. 77.52 (1) (b), Stats., certain leased property affixed to real property under s. 77.52 (1) (c), Stats., and digital goods under s. 77.52 (1) (d), Stats., became effective October 1, 2009, pursuant to 2009 Wis. Act 2.

History: Cr. Register, March, 1979, No. 279, eff. 4-1-79; am. (2), (4) (b) and (5) (d), r. and recr. (3), Register, September, 1982, No. 321, eff. 10-1-82; am. (2) (b), (3) (a) and (b) and (5) (b), Register, September, 1984, No. 345, eff. 10-1-84; cr. (2) (c), r. (1) (b) and (3), renum. (1) (a) to be (1) and am., renum. (2) (a), (b) and (c) to be (4) (a), (c) and (b) and am., renum. (4) to be (2) and am. (2) (a) and (b), renum. (5) (a), (b), (c) and (d) to be (3) (b), (a), (c) and (d), Register, June, 1991, No. 426, eff. 7-1-91; correction in (2) (a) made under 13.93 (2m) (b) 7., Stats., Register, August, 1999, No. 524; am. (2) (b), r. (2) (c), cr. (3) (intro.), (b), (c) and (d), renum. (3) (a) to (d) and (4) to be (3) (a) 1., 2. and 3, (4) and (5) and am. (4) and (5) (c), Register, October, 1999, No. 526, eff. 11-1-99; CR 02-053: renum. (2) (a) and (4) to be (2) and (4) (a) and am., r. (2) (b), cr. (2m) and (4) (b), am. (5) (a), r. and recr. (5) (c) Register November 2002 No. 563, eff. 12-1-02; EmR0924: emerg. am. (1), (2m) (b), (3) (intro.), (5) (a), (c) 1. to 3., renum. (2m) (a) to be (2m) (a) (intro.) and am., cr. (2m) (a) 1. and 2., eff. 10-1-09; CR 09-090: am. (1), (2m) (b), (3) (intro.), (5) (a), (c) 1. to 3., renum. (2m) (a) to be (2m) (a) (intro.) and am., cr. (2m) (a) 1. and 2. Register May 2010 No. 653, eff. 6-1-10; CR 10-094: am. (3) (a) 3., (b) 1. (intro.), b., (c), (d) 1., (4) (a), (5) (b) Register November 2010 No. 659, eff. 12-1-10.

Exhibit A
2015 Assembly Bill 313 and Senate Bill 227 – Signed by Governor 12-16-2015
Wisconsin Administrative Rule Tax 11

AN ACT ***to create*** 77.54 (9m) of the statutes; **relating to:** a sales and use tax exemption for building materials that become a part of a facility for a local unit of government or nonprofit organization.

Analysis by the Legislative Reference Bureau

Under this bill, the sale of tangible personal property that becomes a component of a facility in this state that is owned by a county, municipality, school district, or nonprofit organization is exempt from the sales tax and the use tax. The exemption applies to tangible personal property purchased by a construction contractor who transfers the property to the county, municipality, school district, or nonprofit organization as part of constructing the facility.

Under current law, counties, municipalities, school districts, and nonprofit organizations are exempt from paying the sales tax and the use tax on purchases of tangible personal property. Currently, a construction contractor hired by the county, municipality, school district, or nonprofit organization may not receive the exemption for property purchased by the contractor to be used for a county, municipality, school district, or nonprofit organization construction project.

Because this bill relates to an exemption from state or local taxes, it may be referred to the Joint Survey Committee on Tax Exemptions for a report to be printed as an appendix to the bill.

For further information see the ***state and local*** fiscal estimate, which will be printed as an appendix to this bill.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 77.54 (9m) of the statutes is created to read:

77.54 **(9m)** The sales price from the sale of and the storage, use, or other consumption of tangible personal property, or items or property under s. 77.52 (1) (b) or (c), sold to a construction contractor who, in fulfillment of a real property construction activity, transfers the tangible personal property, or items or property under s. 77.52 (1) (b) or (c), to an entity described under sub. (9a) (b) or (f), if such tangible personal property, or items or property, becomes a component of a facility in this state that is owned by the entity. In this subsection, "facility" means any building, shelter, parking lot, parking garage, athletic field, athletic park, storm sewer, water supply system, or sewerage and waste water treatment facility, but does not include a highway, street, or road.

SECTION 2. Initial applicability.

(1) This act first applies to contracts entered into on January 1, 2016.

SECTION 3. Effective date.

(1) This act takes effect on January 1, 2016.

(End)

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WISCONSIN SALES AND USE TAX EXEMPTION CERTIFICATE

Check One ► ☐ Single Purchase ☐ Continuous

Purchaser's Business Name	Purchaser's Address

The above purchaser, whose signature appears on the reverse side of this form, claims exemption from Wisconsin state, county, baseball or football stadium, local exposition, and premier resort sales or use tax on the purchase, lease, license, or rental of tangible personal property, property under sec. 77.52(1)(b), items under sec. 77.52(1)(c), goods under sec. 77.52(1)(d), or taxable services, as indicated by the box(es) checked below.

I hereby certify that I am engaged in the business of selling, leasing, licensing, or renting: _____

_____

(Purchaser's description of property, items, goods, or services sold by purchaser.)

Purchaser's description of property or services purchased (itemize property, items, or goods purchased if "single purchase"):

_____

_____

Seller's Name	Seller's Address

REASON FOR EXEMPTION

☐ **Resale** (Enter purchaser's seller's permit or use tax certificate number) _____

Manufacturing and Biotechnology

☐ Tangible personal property (TPP) or item under s.77.52(1)(b) that is used exclusively and directly by a manufacturer in manufacturing an article of TPP or items or property under s.77.52(1)(b) or (c) that is destined for sale and that becomes an ingredient or component part of the article of TPP or items or property under s.77.52(1)(b) or (c) destined for sale or is consumed or destroyed or loses its identity in manufacturing the article of TPP or items or property under s.77.52(1)(b) or (c) destined for sale.

☐ Machines and specific processing equipment and repair parts or replacements thereof, exclusively and directly used by a manufacturer in manufacturing tangible personal property or items or property under s.77.52(1)(b) or (c) and safety attachments for those machines and equipment.

☐ The repair, service, alteration, fitting, cleaning, painting, coating, towing, inspection, and maintenance of machines and specific processing equipment, that the above purchaser would be authorized to purchase without sales or use tax, at the time the service is performed. Tools used to repair exempt machines are not exempt.

☐ Fuel and electricity consumed in manufacturing tangible personal property or items or property under s.77.52(1)(b) or (c) in this state.
Percent of fuel exempt: _____ % Percent of electricity exempt: _____ %

☐ Portion of the amount of fuel converted to steam for purposes of resale. Percent of fuel exempt: _____ %

☐ Property used exclusively and directly in qualified research, by persons engaged in manufacturing at a building assessed under s. 70.995, by persons engaged primarily in biotechnology in Wisconsin, or a combined group member conducting qualified research for another combined group member that meets these requirements.

Farming

(To qualify for this exemption, the purchaser must use item(s) exclusively and directly in the business of farming, including dairy farming, agriculture, horticulture, floriculture, silviculture, or custom farming services.)

☐ Tractors (except lawn and garden tractors), all-terrain vehicles (ATV) and farm machines, including accessories, attachments, and parts, lubricants, nonpowered equipment, and other tangible personal property or items or property under s.77.52(1)(b) or (c) that are used exclusively and directly, or are consumed or lose their identities in the business of farming. This includes services to the property and items above.

☐ Feed, seeds for planting, plants, fertilizer, soil conditioners, sprays, pesticides, and fungicides.

☐ Breeding and other livestock, poultry, and farm work stock.

☐ Containers for fruits, vegetables, grain, hay, and silage (including containers used to transfer merchandise to customers), and plastic bags, sleeves, and sheeting used to store or cover hay and silage. Baling twine and baling wire.

☐ Animal waste containers or component parts thereof (may only mark certificate as "Single Purchase").

☐ Animal bedding, medicine for farm livestock, and milk house supplies.

This Form May Be Reproduced

Governmental Units and Other Exempt Entities

Enter CES No., if applicable

- ☐ The United States and its unincorporated agencies and instrumentalities.
- ☐ Any federally recognized American Indian tribe or band in this state.
- ☐ Wisconsin state and local governmental units, including the State of Wisconsin or any agency thereof, Wisconsin counties, cities, villages, or towns, and Wisconsin public schools, school districts, universities, or technical college districts.
- ☐ Organizations organized and operated exclusively for religious, charitable, scientific, or educational purposes, or for the prevention of cruelty to children or animals. CES Number _____ (Required for Wisconsin organizations).

Other

- ☐ Containers and other packaging, packing, and shipping materials, used to transfer merchandise to customers of the purchaser.
- ☐ Trailers and accessories, attachments, parts, supplies, materials, and service for motor trucks, tractors, and trailers which are used exclusively in common or contract carriage under LC, IC, or MC No. (if applicable) _____.
- ☐ Machines and specific processing equipment used exclusively and directly in a fertilizer blending, feed milling, or grain drying operation, including repair parts, replacements, and safety attachments.
- ☐ Building materials acquired solely for and used solely in the construction or repair of holding structures used for weighing and dropping feed or fertilizer ingredients into a mixer or for storage of such grain, if such structures are used in a fertilizer blending, feed milling, or grain drying operation.
- ☐ Tangible personal property purchased by a person who is licensed to operate a commercial radio or television station in Wisconsin, if the property is used exclusively and directly in the origination or integration of various sources of program material for commercial radio or television transmissions that are generally available to the public free of charge without a subscription or service agreement.
- ☐ Fuel and electricity consumed in the origination or integration of various sources of program material for commercial radio or television transmissions that are generally available to the public free of charge without a subscription or service agreement.

  Percent of fuel exempt: _____ % Percent of electricity exempt: _____ %
- ☐ Tangible personal property and items, property and goods under s.77.52(1)(b), (c), and (d) to be resold by _____ on my behalf where _____ is registered to collect and remit sales tax to the Department of Revenue on such sales.
- ☐ Tangible personal property, property, items and goods under s.77.52(1)(b), (c), and (d), or services purchased by a Native American with enrollment # _____, who is enrolled with and resides on the _____ Reservation, where buyer will take possession of such property, items, goods, or services.
- ☐ Tangible personal property and items and property under s.77.52(1)(b) and (c) becoming a component of an industrial or municipal waste treatment facility, including replacement parts, chemicals, and supplies used or consumed in operating the facility. Caution: Do not check the "continuous" box at the top of page 1.
- ☐ Portion of the amount of electricity or natural gas used or consumed in an industrial waste treatment facility. (Percent of electricity or natural gas exempt _____ %)
- ☐ Electricity, natural gas, fuel oil, propane, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel for **residential** or **farm** use.

	% of Electricity Exempt	% of Natural Gas Exempt	% of Fuel Exempt
☐ Residential	_____%	_____%	_____%
☐ Farm	_____%	_____%	_____%

  Address Delivered: _____
- ☐ Percent of printed advertising material solely for out-of-state use. _____%
- ☐ Catalogs, and the envelopes in which the catalogs are mailed, that are designed to advertise and promote the sale of merchandise or to advertise the services of individual business firms.
- ☐ Computers and servers used primarily to store copies of the product that are sent to a digital printer, a plate-making machine, or a printing press or are used primarily in prepress or postpress activities, by persons whose NAICS code is 323111, 323117, or 323120.
- ☐ Purchases from out-of-state sellers of tangible personal property that are temporarily stored, remain idle, and not used in this state and that are then delivered and used solely outside this state, by persons whose NAICS code is 323111, 323117, or 323120.
- ☐ Other purchases exempted by law. (State items and exemption). _____

I hereby certify that if the item(s) being purchased are not used in an exempt manner, I will remit use tax on the purchase price at the time of first taxable use. I understand that failure to remit the use tax may result in a future liability that may include tax, interest, and penalty.

Signature of Purchaser	Print or Type Name	Title	Date

(DETACH AND PRESENT TO SELLER)

INSTRUCTIONS

This certificate may be used to claim exemption from Wisconsin state, county, baseball and football stadium, local exposition, and premier resort sales or use taxes.

Under the sales and use tax law, all receipts from sales of tangible personal property, property, items and goods under sec. 77.52(1)(b), (c), and (d), or taxable services are subject to the tax until the contrary is established. However, a seller who receives a fully completed exemption certificate no later than 90 days after the date of sale is relieved of any responsibility for collection or payment of the tax upon transactions covered by the certificate. A fully completed certificate is one which is completely filled in and indicates the reason for exemption.

RESALE: A purchaser using the resale exemption is attesting that the tangible personal property, property, items, or goods under sec. 77.52(1)(b), (c), or (d), or taxable services being purchased will be resold, leased, licensed, or rented. However, in the event any such property, items, or goods is used for any purpose other than retention, demonstration, or display while holding it for sale, lease, license, or rental in the regular course of business, the purchaser is required to report and pay the tax on the purchase of the property, item, or good.

The following purchasers may make purchases for resale even though they do not hold a Wisconsin seller's permit or use tax certificate: (a) A wholesaler who only sells to other sellers for resale may insert "Wholesale only" in the space for the seller's permit number; (b) A person who only sells or repairs exempt property, such as to a manufacturer or farmer, may insert "Exempt sales only"; (c) A nonprofit organization may insert "Exempt sales only" if its subsequent sales of the tangible personal property, property, items, or goods under sec. 77.52(1)(b), (c), or (d), or taxable services are exempt as occasional sales.

A seller is allowed to accept an exemption certificate from an out-of-state retailer claiming the resale exemption for tangible personal property and items, property, and goods under sec. 77.52(1)(b), (c) and (d), Wis. Stats., drop shipped to a Wisconsin location, regardless of whether or not the out-of-state retailer holds a Wisconsin seller's permit. The out-of-state retailer's permit number, if the other state issues one, and state should be listed on the exemption certificate. If the exemption certificate does not list the Wisconsin seller's permit number or the out-of-state retailer's permit number and state, to be fully complete and valid the exemption certificate must contain a statement indicating the out-of-state retailer is a seller that is not required to hold a permit.

A resale exemption may be granted if the purchaser is unable to ascertain at the time of purchase whether the property will be sold or will be used for some other purpose. If the buyer purchases an item without tax for resale, but uses the item, the buyer owes use tax on its purchase of the item.

MANUFACTURING: "Manufacturing" means the production by machinery of a new article of tangible personal property or items or property under sec. 77.52(1)(b) or (c) with a different form, use, and name from existing materials, by a process popularly regarded as manufacturing, and that begins with the conveying raw materials and supplies from plant inventory to the place where work is performed in the same plant and ends with conveying finished units of tangible personal property or items or property under sec. 77.52(1)(b) or (c) to the point of first storage in the same plant.

FARMING: This certificate may not be used by farmers to claim exemption for the purchase of motor vehicles or trailers for highway use, lawn or garden tractors, snowmobiles, or for items used for the personal convenience of the farmer. When claiming an exemption for an ATV which is also registered for public use, a written description including the percentages of time for personal and farm use, must be submitted with the ATV Registration Application.

The sales price from the sale of electricity, natural gas, and other fuels for use in farming are exempt all 12 months of the year. Farmers claiming this exemption should check the box for electricity and fuel located in the "Other" section.

This certificate cannot be used as an exemption for paying Wisconsin motor vehicle fuel tax.

GOVERNMENTAL UNITS AND OTHER EXEMPT ENTITIES: A seller may accept exemption certificates from federal and Wisconsin governmental units and federally recognized American Indian tribes or bands in Wisconsin. Instead of obtaining an exemption certificate, a seller may (1) accept a purchase order from the governmental unit or tribe or band, or (2) record the governmental unit or tribe or band's Certificate of Exempt Status (CES) number on its invoices. Governmental units of other countries and states are not exempt from Wisconsin sales tax.

The exemption for the United States and its unincorporated agencies and instrumentalities may also be claimed by any incorporated agency or instrumentality of the United States wholly owned by the United States or by a corporation wholly owned by the United States.

The exemption for Wisconsin governmental units and other exempt entities may be claimed by: Local Exposition District, Professional Baseball Park District, Professional Football Stadium District, UW Hospitals and Clinics Authority, Wisconsin Aerospace Authority, Health Insurance Risk-Sharing Plan Authority, Wisconsin Economic Development Authority, Fox River Navigational System Authority, public inland lake protection and rehabilitation districts, municipal public housing authorities, uptown business improvement districts, local cultural arts districts, county-city hospitals, sewerage commissions, metropolitan sewerage districts, or joint local water authorities.

Organizations holding a Certificate of Exempt Status (CES) number: Wisconsin organizations organized and operated exclusively for religious, charitable, scientific, or educational purposes, or for the prevention of cruelty to children or animals, may purchase products or services exempt from Wisconsin sales tax if the organization holds a CES number issued by the Wisconsin Department of Revenue. Wisconsin and federal governmental units, and any federally recognized American Indian tribe or band in Wisconsin, will also qualify for a CES.

A similar out-of-state organization, generally organized under sec. 501(c)(3) of the Internal Revenue Code, may purchase products or services exempt from Wisconsin sales tax even though it has not been issued a CES number. This exemption does *not* apply to out-of-state public schools, including public colleges and universities, and governmental units from other states.

Purchases (for lodging, meals, auto rental, etc.) by employees/representatives of exempt organizations performing organization business, are exempt from sales tax, provided 1) the retailer issues the billing or invoice in the name of the exempt organization, 2) the CES number is entered on the billing or invoice, and 3) the retailer retains a copy of that document.

OTHER:

Containers: This exemption applies regardless of whether or not the containers are returnable. Containers used by the purchaser only for storage or to transfer merchandise owned by the purchaser from one location to another do not qualify for the exemption.

Common or contract carriers: The exemption available to common or contract carriers for certain vehicles and repairs listed on this certificate applies only to those units used "exclusively" in such common or contract carriage. A carrier may qualify for the common or contract carriage exemption even if it does not hold a LC or IC number. The fact that a carrier holds a LC or IC number is not in itself a reason for exemption. A carrier may qualify for the common or contract carrier exemption even if it does not hold an LC or IC number.

Waste treatment facilities: The exemption applies to the sale of tangible personal property and items and property under sec. 77.52(1)(b) and (c) to a contractor for incorporation into real property which is part of an industrial or commercial waste treatment facility that qualifies for property tax exemption or a Wisconsin or federal governmental waste treatment facility.

Electricity, natural gas, fuel oil, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel:

- The sales price from the sale of electricity and natural gas for residential use during the months of November through April are exempt from sales and use tax.
- The sales price from sales of fuel oil, propane, coal, steam, corn, and wood (including wood pellets which are 100% wood) used for fuel sold for residential use are exempt from sales or use tax. Wood pellets are considered 100% wood even though the pellets may contain a small amount of binding material used to form the pellets.
- The sales price from the sale of fuel and electricity for use in farming are exempt all year.

A retailer of electricity, fuel, or natural gas shall have a signed exemption certificate for exempt sales for residential or farm use unless any of the following apply:

1. 100% of the electricity, fuel, or natural gas is for exempt use.
2. The sale is to an account which is properly classified as residential or farm pursuant to schedules which are filed for rate tariff with the Wisconsin Public Service Commission which are in force at the time of sale.
3. The sale is to an account which is properly classified as residential or farm for classification purposes as directed by the Federal Rural Electrification Administration.

"Farm use" means used in farming, including use in a tractor or other farm machines used directly in farming, in a furnace heating a farm building, in providing lighting in farm buildings, and use in operating motors of machines used directly in farming.

"Residential use" means use in a structure or portion of a structure which is a person's permanent principal residence. It does not include use in motor homes, travel trailers, other recreational vehicles, or transient accommodations. "Transient accommodations" means rooms or lodging available to the public for a fee for a continuous period of less than one month in a building such as a hotel, motel, inn, tourist home, tourist house or court, summer camp, resort lodge, or cabin.

Other purchases exempted by law include:

1. Printed material which is designed to advertise and promote the sale of merchandise, or to advertise the services of individual business firms, which printed material is purchased and stored for the purpose of subsequently transporting it outside the state by the purchaser for use thereafter solely outside the state.
2. Parts, supplies, or repairs for a school bus used exclusively as a contract carrier pursuant to a contract with a school or other organization.
3. Waste reduction and recycling machinery and equipment, including parts and repairs, which are exclusively and directly used for waste reduction and recycling activities.
4. Railway cars, locomotives, and other rolling stock used in railroad operations, or accessories, attachments, parts, lubricants, or fuel therefor.
5. Commercial vessels and barges of 50-ton burden or over engaged in interstate or foreign commerce or commercial fishing, and accessories, attachments, parts, and fuel therefor.
6. Fuel sold for use in motorboats that are regularly employed in carrying persons for hire for sport fishing in and upon the outlying waters, as defined in sec. 29.001(63), Wis. Stats., and the rivers and tributaries specified in sec. 29.2285(2)(a)1. and 2., Wis. Stats., if the owner and all operators are licensed under sec. 29.514, Wis. Stats., to operate the boat for that purpose.
7. A product whose power source is the wind, direct radiant energy received from the sun, or gas generated by the anaerobic digestion of animal manure and other agricultural waste, if the product produces at least 200 watts of alternating current or at least 600 British thermal units per day, but not including a product that is an uninterruptible power source that is designed primarily for computers.
8. Effective July 1, 2013, snowmaking and snow-grooming machines and equipment, including accessories, attachments, and parts for the machines and fuel and electricity used to operate such machines and equipment, that are used exclusively and directly for snowmaking at ski hills, ski slopes, and ski trails.
9. Effective July 1, 2013, advertising and promotional direct mail and printing services used to produce advertising and promotional direct mail.

SIGNATURE: For corporations, this form must be signed by an employee or officer of the corporation.

QUESTIONS: If you have questions, please contact us.

WISCONSIN DEPARTMENT OF REVENUE
Customer Service Bureau
PO Box 8949
Madison WI 53708-8949

Phone: (608) 266-2776
Fax: (608) 267-1030
Website: revenue.wi.gov

EXHIBIT B

A LISTING OF THE DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE

Engineer shall furnish a Resident Project Representative (RPR), assistants and other field staff to assist Engineer in observing performance of the Work of the Contractor.

Through more extensive on-site observations of the Work in progress and field checks of materials and equipment by the RPR and assistants, Engineer shall endeavor to provide further protection for Owner against defects and deficiencies in the Work; but, the furnishing of such services will not make Engineer responsible for or give Engineer control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs, or responsibility for Contractor's failure to perform the Work in accordance with the Contract Documents.

The duties and responsibilities of the RPR are limited to those of Engineer in Engineer's agreement with the Owner and in the construction Contract Documents, and are further limited and described as follows:

A. GENERAL

RPR is Engineer's 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 on-site work shall in general be with Engineer and Contractor keeping Owner advised as necessary. RPR's dealings with subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner with the knowledge of and under the direction of Engineer.

B. DUTIES AND RESPONSIBILITIES OF RPR

1. Schedules: Review the progress schedule, schedule of Shop Drawing submittals and schedule of values prepared by Contractor and consult with Engineer concerning acceptability.

2. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

3. Liaison:
   a) Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding the intent of the Contract Documents; and assist Engineer in serving as Owner's liaison with Contractor.
   b) Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

4. Review of Work, Rejection of Defective Work, Inspections and Tests:
   a) Conduct on-site observations of the 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 Work is unsatisfactory, faulty or defective or does not conform to 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 Work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

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

5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed.

6. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to Engineer.

7. Records:
   a) Maintain at the job site orderly files for correspondence, reports of job conferences, Shop Drawings and samples, reproductions of original Contract Documents including Work Directive Changes, Addenda, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project related documents.
   b) Keep a diary or log book and send copies to Engineer.
   c) Record names, addresses and telephone numbers of all Contractors, subcontractors and major suppliers of materials and equipment.

8. Reports:
   a) Furnish Engineer periodic reports as required of progress of the Work.
   b) Consult with Engineer in advance of scheduled major tests, inspections or start of important phases of the Work.

9. 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.

10. Completion:
    a) Before Engineer issues a Certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.
    b) Conduct final inspection in the company of Engineer, Owner and Contractor and prepare a final list of items to be completed or corrected.
    c) Observe that items on final list have been completed or corrected and make recommendations to Engineer concerning acceptance.

C. LIMITATIONS OF AUTHORITY

Resident Project Representative:

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by Engineer.

2. Shall not exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Shall not undertake any of the responsibilities of Contractor, subcontractors or Contractor's superintendent.

4. Shall not advise on, issue directions relative to or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by the Contract Documents.

5. Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with the Work.

6. Shall not accept Shop Drawing or sample submittals from anyone other than Contractor.

7. Shall not authorize Owner to occupy the Project in whole or in part.

8. Shall not participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

STATE OF WISCONSIN
PREVAILING WAGE RATE DETERMINATION

State of Wisconsin Department of Workforce Development Equal Rights Division	**DEPARTMENTAL ORDER**

ISSUE DATE: 12/15/2015

PROJECT:

RIVER BEND ROAD RESURFACING / LIFT STATION
GRAFTON VILLAGE, OZAUKEE COUNTY, WI
Determination No. 201502989 [Owner Project No. 5582]

PROJECT OWNER:	REQUESTER:
DAVID MURPHY, DIRECTOR OF PUBLIC WORKS VILLAGE OF GRAFTON 675 N GREEN BAY ROAD GRAFTON, WI 53024	PAUL A TRAEGER, PROJ MGR APPLIED TECHNOLOGIES 16815 W WISCONSIN AVE BROOKFIELD, WI 53005
ADDITIONAL CONTACT:	**NOTE:** The Requester must provide a copy of this Project Determination and enclosures to the Project Owner and Additional Contact.

The department received an application for prevailing wage rate determination for the above-captioned project. The department conducted a survey to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The survey's findings appear in the attached project determination.

If you believe that the wage rate for any trade or occupation does not accurately reflect the prevailing wage rate in the city, village or town where the project is located, you may ask the department to conduct an administrative review of such wage rate. You must submit this request in writing within 30 days from the date indicated above. Additionally, your request must include wage rate information from at least three similar projects in the city, village or town where the proposed project is located and on which some work has been performed by the contested trade(s) during the current survey period and was previously considered by the department in issuing the attached determination. See DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903(3)(br), Stats., or s. 103.49(3)(c), Stats., for a complete explanation of the administrative review process.

Enclosures

It is hereby ordered that the prevailing wage rates set forth in the attached project determination shall only be applicable to the above referenced project. This order is a **FINAL ORDER** of the department unless a timely request for an administrative review is filed with the department.

ISSUED BY:

Equal Rights Division
Labor Standards Bureau
Construction Wage Standards Section
P.O. Box 8928, Madison, WI 53708-8928
(608)266-6861

Web Site: http://dwd.wisconsin.gov/er/

PREVAILING WAGE RATE DETERMINATION
Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 12/15/2015

DETERMINATION NUMBER: 201502989

EXPIRATION DATE: Prime Contracts MUST Be Awarded or Negotiated On Or Before 6/12/2016. If NOT, You MUST Reapply.

PROJECT NAME: RIVER BEND ROAD RESURFACING / LIFT STATION

PROJECT NO: 5582

PROJECT LOCATION: GRAFTON VILLAGE, OZAUKEE COUNTY, WI

CONTRACTING AGENCY: VILLAGE OF GRAFTON

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm.
OVERTIME:	Time and one-half must be paid for all hours worked: - over 10 hours per day on prevailing wage projects - over 40 hours per calendar week - Saturday and Sunday - on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25; - The day before if January 1, July 4 or December 25 falls on a Saturday; - The day following if January 1, July 4 or December 25 falls on a Sunday. Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime. A DOT Premium (discussed below) may supersede this time and one-half requirement.
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whevenever such pay is applicable.
DOT PREMIUM:	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
APPRENTICES:	Pay apprentices a percentage of the applicable journeyperson's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project** . A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.
(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.
(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.
2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.
3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.
5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
101	Acoustic Ceiling Tile Installer Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.65/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.13	20.61	54.74
102	Boilermaker Future Increase(s): Add $1.50/hr. on 01/01/2016	33.35	28.24	61.59
103	Bricklayer, Blocklayer or Stonemason	35.37	18.05	53.42
104	Cabinet Installer Future Increase(s): Add $1.42/hr on 6/1/2015; Add $1.42/hr on 6/1/2016.	32.72	16.00	48.72
105	Carpenter Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.65/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.13	20.61	54.74
106	Carpet Layer or Soft Floor Coverer	33.68	19.92	53.60
107	Cement Finisher Future Increase(s): Add $1.30 on 06/01/2015; Add $1.40 on 06/06/2016	32.09	19.21	51.30
108	Drywall Taper or Finisher Future Increase(s): Add $.90/hr eff. 06/01/2015; Add $1.00/hr eff. 06/01/2016; Add $1.05/hr eff. 06/01/2017	29.97	20.74	50.71
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.93	22.77	56.70
110	Elevator Constructor	43.21	25.49	68.70

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
111	Fence Erector	23.73	19.09	42.82
112	Fire Sprinkler Fitter	38.50	20.15	58.65
113	Glazier Future Increase(s): Add $.75/hr eff. 06/01/2015; Add $.90/hr eff. 06/01/2016	34.19	18.50	52.69
114	Heat or Frost Insulator	33.43	25.78	59.21
115	Insulator (Batt or Blown) Future Increase(s): Add $1.42/hr on 6/1/2015; Add $1.42/hr on 6/1/2016.	32.72	16.00	48.72
116	Ironworker Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.77	23.97	54.74
117	Lather	33.68	19.81	53.49
118	Line Constructor (Electrical)	39.50	20.34	59.84
119	Marble Finisher	20.00	0.52	20.52
120	Marble Mason	35.37	18.05	53.42
121	Metal Building Erector	24.25	10.85	35.10
122	Millwright Future Increase(s): Add $1.35/hr on 6/1/2015; Add $1.35/hr on 6/1/2016.	29.03	25.78	54.81
123	Overhead Door Installer	20.00	6.00	26.00
124	Painter Future Increase(s): Add $.90/hr on 06/01/2015; Add $1.00/hr on 06/01/2016; Add $1.05/hr on 06/01/2017 Premium Increase(s): Add $.20/hr for paperhanging; Add $.35/hr for bridge, iron and drywall; Add $.75/hr for spraying and sandblasting; Add $.60/hr for EIFS work; Add $1.00/hr for lead based paint removal.	29.62	20.74	50.36
125	Pavement Marking Operator	30.10	18.09	48.19
126	Piledriver Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.60/hr on 6/1/2016. Premium Increase(s): Add $.65/hr for Piledriver Loftsman; Add $.75/hr for Sheet Piling Loftsman. DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.11	26.51	56.62

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
127	Pipeline Fuser or Welder (Gas or Utility)	31.88	20.89	52.77
129	Plasterer Premium Increase(s): Add $.40/hr for swing stage work.	31.21	19.93	51.14
130	Plumber	38.37	19.55	57.92
132	Refrigeration Mechanic Future Increase(s): Add $1.70 on 6/1/15	41.01	21.54	62.55
133	Roofer or Waterproofer Future Increase(s): Add $1.25/hr eff. 06/01/2015; Add $1.25/hr eff. 06/01/2016	29.65	18.15	47.80
134	Sheet Metal Worker	36.17	15.57	51.74
135	Steamfitter	41.01	21.54	62.55
137	Teledata Technician or Installer Future Increase(s): Add $.86/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.63	17.25	42.88
138	Temperature Control Installer	39.76	21.09	60.85
139	Terrazzo Finisher	20.00	0.52	20.52
140	Terrazzo Mechanic	31.18	17.35	48.53
141	Tile Finisher Future Increase(s): Add $.20/hr on 1/ 5/2015	24.24	17.54	41.78
142	Tile Setter	30.38	17.33	47.71
143	Tuckpointer, Caulker or Cleaner Future Increase(s): Add $1.35on 06/01/2015; Add $1.45 on 06/01/2016 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.28	18.48	52.76
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
146	Well Driller or Pump Installer	25.32	15.65	40.97
147	Siding Installer	36.17	19.44	55.61
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	30.16	15.11	45.27

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.71	47.31
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	14.49	42.14
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.83	15.01	42.84
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	24.00	11.57	35.57

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle	34.07	18.10	52.17
203	Three or More Axle	22.00	16.03	38.03
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1.60/hr on 5/30/2016.	33.02	18.70	51.72
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	22.00	16.03	38.03

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $1.35/hr eff. 06/01/2015; Add $1.25/hr eff. 06/06/2016 Premium Increase(s): Add $.11 for mortar mixer, fork lift operator, air and electric equipment and power buggy operators; Add $.22 for jackhammer operator, certified welder, gunite machineman.	29.01	17.22	46.23
302	Asbestos Abatement Worker	22.05	19.16	41.21
303	Landscaper	13.00	10.76	23.76
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	20.13	17.79	37.92
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased) Premium Increase(s): DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	18.06	16.76	34.82
314	Railroad Track Laborer	14.50	4.39	18.89

315	Final Construction Clean-Up Worker	28.31	11.95	40.26

HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.60/hr on 5/30/2016.	34.47	18.70	53.17
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under). Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.60/hr on 5/30/2016.	34.17	18.70	52.87
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.60/hr on 5/30/2016.	34.47	18.70	53.17
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add $.50/hr for Friction Crane, Lattice Boom or Crane Certification (CCO).	41.65	21.71	63.36

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr. Cranes with boom length over 200 ft. not exceeding 300 ft. OR lifting capacity over 200 ton not exceeding 300 ton add $.50/hr. Over 300 ton OR 300 ft. add $.01/hr. per foot OR ton whichever is greater.	40.61	20.15	60.76
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr.	40.11	20.15	60.26

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Crane Operators with CCO certification add $.50/hr.	39.61	20.15	59.76
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket).	32.89	21.51	54.40
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add $1.55/hr on 6/1/2015.	37.04	20.15	57.19

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.55/hr on 6/1/2015.	31.89	20.15	52.04
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add $1/hr on 6/1/2015; Add $1/hr on 5/30/2016.	36.34	22.14	58.48
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add $1.65/hr on 6/1/2015.	34.06	19.35	53.41
516	Fiber Optic Cable Equipment	28.89	17.95	46.84

SEWER, WATER OR TUNNEL CONSTRUCTION

Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	35.37	18.05	53.42
105	Carpenter Future Increase(s): Add $1.50/hr on 6/1/2015; Add $1.65/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.13	20.61	54.74
107	Cement Finisher Future Increase(s): Add $1.87 on 6/1/15; Add $1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician	47.76	0.00	47.76
111	Fence Erector	23.73	19.09	42.82
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	20.34	59.84
125	Pavement Marking Operator	30.10	18.09	48.19
126	Piledriver	29.56	25.71	55.27
130	Plumber	21.50	0.00	21.50
135	Steamfitter	39.76	21.09	60.85
137	Teledata Technician or Installer	24.89	17.15	42.04
143	Tuckpointer, Caulker or Cleaner	33.76	17.82	51.58
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
146	Well Driller or Pump Installer	25.32	15.65	40.97
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle Future Increase(s): Add $1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	18.00	0.00	18.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	32.89	18.96	51.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	18.00	0.00	18.00

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer Future Increase(s): Add $1.35/hr eff. 06/01/2015; Add $1.25/hr eff. 06/06/2016 Premium Increase(s): Add $2.29 for bottomman; Add $2.15 for concrete manhole builder, bracer, jointman, or pipelayer; Add $5.44 for blaster. Add $2.00 for all tunnel work under 15 lbs. compressed air; Add $2.00 for 0-30 lbs. compressed air; Add $3.00 for over 30 lbs. compressed air.	29.16	17.72	46.88
303	Landscaper	39.43	0.00	39.43
304	Flagperson or Traffic Control Person	31.95	0.00	31.95
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.71	16.01	33.72

314	Railroad Track Laborer	14.50	4.39	18.89

HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	37.24	20.10	57.34
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	36.46	20.10	56.56
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add $1.55/hr on 6/1/2015. Premium Increase(s): Add $.25/hr for operating tower crane.	35.51	20.10	55.61

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	36.79	19.15	55.94
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.	50.50	0.42	50.92
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	31.64	19.15	50.79
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
103	Bricklayer, Blocklayer or Stonemason	35.37	18.05	53.42
105	Carpenter Future Increase(s): Add $1.42/hr on 6/1/2015; Add $1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
107	Cement Finisher	30.96	18.53	49.49
109	Electrician	32.04	23.38	55.42
111	Fence Erector	23.73	19.09	42.82
116	Ironworker	30.52	23.47	53.99
118	Line Constructor (Electrical)	39.50	20.34	59.84
124	Painter	29.52	19.99	49.51
125	Pavement Marking Operator	30.10	18.09	48.19
126	Piledriver	29.56	25.71	55.27
133	Roofer or Waterproofer	29.40	17.05	46.45
137	Teledata Technician or Installer	24.89	17.15	42.04
143	Tuckpointer, Caulker or Cleaner	33.76	17.82	51.58
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
201	Single Axle or Two Axle Future Increase(s): Add $1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	18.00	0.00	18.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add $1.60/hr on 6/2/2015; Add $1.60/hr on 6/3/2016.	33.69	19.78	53.47
205	Pavement Marking Vehicle	20.85	11.02	31.87
206	Shadow or Pilot Vehicle	24.37	17.77	42.14
207	Truck Mechanic	18.00	0.00	18.00

LABORERS

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
301	General Laborer	24.75	19.69	44.44
303	Landscaper Future Increase(s): Add $1.05/hr eff. 06/01/2015; Add $1.00/hr eff. 06/01/2016; Add $1.00/hr eff. 06/01/2017 Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	27.06	20.03	47.09
304	Flagperson or Traffic Control Person	25.67	12.66	38.33
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.71	16.01	33.72
314	Railroad Track Laborer	14.50	4.39	18.89

HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.	37.72	21.15	58.87
542	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.	37.22	21.15	58.37

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
543	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.	35.72	17.85	53.57
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (WIth or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.	36.46	21.15	57.61
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	35.17	20.40	55.57
546	Fiber Optic Cable Equipment.	28.89	17.95	46.84

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	36.72	20.40	57.12
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.	37.22	21.15	58.37

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017.	36.17	20.80	56.97
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017.	36.17	20.80	56.97

CODE	Fringe Benefits Must Be Paid On All Hours Worked TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY $	HOURLY FRINGE BENEFITS $	TOTAL $
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add $1.25/hr on 6/1/2015; Add $1.30/hr on 6/1/2016; Add $1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add $1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.	36.17	21.15	57.32
556	Fiber Optic Cable Equipment.	27.89	17.20	45.09

********** END OF RATES **********

Department of Workforce Development
Equal Rights Division
P.O. Box 8928
Madison, WI 53708-8928
Telephone: (608) 266-6860
Fax: (608) 267-4592
TTY: (608) 264-8752

STATE OF WISCONSIN
DWD
Department of Workforce Development

Scott Walker, Governor
Reginald J. Newson, Secretary

The documents following the Prevailing Wage Rate Determination consist of twenty pages (including this one) of various forms/documents that will be used throughout the completion of the project. The chart below lists the form number, form/document name, the party who uses the document, and the document's number of pages. If you have any questions regarding these forms please call the Prevailing Wage Office at (608)266-6861.

ERD Form Number	Form Name	Party Who Uses the Form	Pages
July 2015 description of recent changes to Wisconsin's prevailing wage laws resulting from enactment of the 2015-17 State Budget Bill.			1
	Prevailing Wage - Public Entity Project Owners	Explanation of project owner responsibilities	2
16056	Post the White Sheet	Contracting agency	1
10908	Consolidated List of Debarred Contractors	Any party contracting someone to complete work on a prevailing wage project	4
	Prevailing Wage – Contractors	Explanation of contractor responsibilities	2
7777	Disclosure of Ownership	Contractors that meet the criteria set out in (3)(A)&(B) of the form	1
5724	Prime Contractor Affidavit of Compliance	Prime contractor files with contracting agency upon completion of the work before receiving final payment	2
10584	Agent or Subcontractor Affidavit of Compliance	Subcontractors file with their awarding contractor upon completion of their work on the project before receiving final payment	2
10880	Request to Employ Subjourneyperson	Contractors wishing to employ a subjourneyperson(s)	1
	Additional General Prevailing Wage Law Information	General information for public entity or any other interested party	3

8/1/2015

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THE 2015-17 BUDGET BILL MADE SIGNIFICANT CHANGES TO WISCONSIN'S PREVAILING WAGE LAWS. HOWEVER, THOSE CHANGES DO NOT GO INTO EFFECT UNTIL JANUARY 1, 2017.

During calendar years 2015 and 2016, DWD will continue to enforce prevailing wage laws for local governmental unit and state agency public works projects under current prevailing wage laws.

2015 Wisconsin Act 55 (the budget bill) repeals the state prevailing wage law for **local governmental units** such as villages, towns, cities, school districts, or sewerage districts effective January 1, 2017. However, if a local governmental unit:

- issues a Request for Bids before January 1, 2017, for a project of public works that is subject to bidding or,
- enters into a contract before January 1, 2017, for a project of public works that is not subject to bidding,

then those public works projects are subject to the current prevailing wage law (§66.0903, Wis. Stats.) through the life of the project. Projects of public works with prevailing wage project determinations issued prior to 2017 continue to be subject to the current prevailing wage law through the life of the project even though the project may have work going on in 2017 or subsequent years.

Contractors working on local governmental unit projects with prevailing wage rate determinations must continue to pay employees the appropriate prevailing wage and maintain required prevailing wage payroll records. For instance, if a contractor is working in 2018 on a public works project with a project determination issued prior to 2017, then the contractor is required to comply with the "old" prevailing wage rate law (§66.0903, Wis. Stats.). After January 1, 2017, DWD will continue to enforce prevailing wage requirements for projects with DWD prevailing wage determinations issued under the "old" prevailing wage laws (§§ 66.0903 & 103.49, Wis. Stats.).

For new public works projects starting on January 1, 2017, state prevailing wage law will only apply to **state agency** and **state highway** projects. Prevailing wage rates applicable to state agencies will be those issued by the U.S. Department of Labor under the Davis-Bacon Act, 40 U.S.C. 3142. The Wisconsin Department of Administration will enforce the new state agency prevailing wage law (§16.856, Wis. Stats.) and the Wisconsin Department of Transportation will continue to enforce prevailing wage on state highway projects (under a law renumbered as §84.062, Wis. Stats.).

As a result of these changes, 2015 will be the last year in which the annual Wisconsin Prevailing Wage Survey will be conducted.

(Drafted July 28, 2015)

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STATE OF WISCONSIN
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PREVAILING WAGE – Public Entity Project Owners

Any public works project that has a total estimated project cost that equals or exceeds single-trade or multiple-trade project thresholds requires a prevailing wage rate determination issued by the Department of Workforce Development (DWD). Public works include erecting, constructing, remodeling, repairing, demolishing, alterations, painting and decorating projects for a local governmental unit or state agency. State law excludes minor service or maintenance work, warranty work, or work under a supply-and-installation contract. There is a statutory definition for most of these exclusions. The prevailing wage law that applies to local governmental units is §66.0903, Wis. Stats. The prevailing wage law that applies to state agencies is §103.49, Wis. Stats. The applicable administrative rules for all public entities are DWD 290 and DWD 294, Wis. Adm. Code.

Thresholds

A "single-trade project of public works" means a project in which a single trade accounts for 85% or more of the total labor cost of the project. The single trade threshold is $48,000.

A "multiple-trade project of public works" means a project in which no single trade accounts for 85% or more of the total labor cost of the project.

(a) The multiple-trade threshold is $100,000, unless a municipality falls under the description in (b).

(b) The multiple-trade threshold of $234,000 applies to public works projects erected, constructed, repaired, remodeled, or demolished by a private contractor for •a city or village with a population less than 2500 or •a town.

A local governmental unit or state agency that has a public works project that equals or exceeds the prevailing wage thresholds must do all of the following:

- Request a prevailing wage rate determination for the project from DWD at least 30 days before soliciting bids or negotiating contracts. An Application for Prevailing Wage Rate Determination is available on the DWD website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm
  To avoid waiting for a project determination use the on-line application system that permits the user to generate a determination immediately and save all documents in PDF form to the user's computer. Use this project determination on line application at the following address:

http://dwd.wisconson.gov/er/prevailing_wage_rate/pw_online_determinations.htm

- Tell potential contractors the project is subject to state prevailing wage law when soliciting bids.

- Include the prevailing wage rate determination in the construction contract, or if there is no written contract, provide a copy of the project determination to each prime contractor.

- Award contracts to contractors who do *not* appear on the "Consolidated List of Debarred Contractors."

- Notify contractors that they are required to have a written substance abuse testing program in place that fulfills the requirements of §103.503, Wis. Stats., before commencing work on the prevailing wage project.

- Post the prevailing wage rate determination on the project site. (This document is often referred to as "the white sheet.")

- Notify project contractors that if DWD finds that a contractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.

- Obtain an Affidavit of Compliance from each prime contractor before making final payment for the project.

If the total estimated cost of the project exceeds the prevailing wage thresholds, a local governmental unit or state agency also must obtain a prevailing wage rate determination under the following circumstances:

- when a completed facility is leased, purchased, lease-purchased or otherwise acquired by or dedicated to a public entity in lieu of the public entity contracting for the project,

- when one public entity does work for another public entity,

- when a *private* entity will construct a road, street, bridge, sanitary sewer or water main project and dedicate it to a local governmental unit or the state for its ownership or maintenance (except for some residential subdivisions).

For more information, visit the prevailing wage website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm. For further assistance, call the Equal Rights Division at 608-266-6861 and ask for prevailing wage.

State of Wisconsin
Department of Workforce Development
Equal Rights Division
Labor Standards Bureau

POST THE WHITE SHEET

As the public entity receiving this prevailing wage rate determination, YOU ARE REQUIRED by law to post the prevailing wage rate determination (i.e., white sheet) in at least one conspicuous and easily accessible place on the project site that is available to all construction workers. The white sheet must remain posted from the onset of the project until all construction labor on the project has been completed.
[*See,* Wis. Admin. Code §DWD 290.12(1)]

Posting the white sheet inside the general contractor's trailer does not meet this requirement. That placement is not available/accessible to all workers and is not a location over which you have control.

If you have questions about posting, please call (608)266-6861 and ask for prevailing wage intake.

Consolidated List of Debarred Contractors
Prepared and Issued By
State of Wisconsin - Department of Workforce Development

This list has been prepared in accordance with the provisions of §§66.0903(12) and 103.49(7), Wis. Stats., and Chapter DWD 294 of the Wisconsin Administrative Code. All contractors on this list were found to have committed a "debarable offense" related to certain labor standard provisions determined or established for a state or local public works project. No state agency, local governmental unit or owner or developer may knowingly solicit bids from, negotiate with or award any contracts to or approve or allow any subcontracts with a debarred contractor, including all divisions, affiliates or other organizational elements of such contractor that are engaged in construction business activities, until the debarment is terminated. The name of each debarred contractor must remain on this list for a period of three (3) years from the termination date indicated below. The contractor is, however, only "debarred" from the "effective date" through the "termination date" indicated for that contractor. Questions regarding this list should be addressed to Jim Chiolino, Equal Rights Division, P. O. Box 8928, Madison, WI 53708 or call (608) 266-3345. Deaf, hearing or speech-impaired callers may contact the department by calling its TDD number (608) 264-8752.

Name of Contractor	Address	Effective Date	Termination Date	Cause Code	Date of Violation(s)	Limitations/ Deviations
A-1 Duran Roofing & Insulation Services, Inc.	3700 N Fratney St Milwaukee, WI 53212 or 8095 NW 64th St Miami, FL 33166	11/1/14	10/31/17	1, 2 and 4	2011-2012	None
Abel, Mike	*See,* Abel Electric, Inc					
Abel Electric, Inc	3385 Belmar Rd Green Bay, WI 54313	9/1/12	8/31/15	1	2011	None
Alpha Electric, LLC	350 Business Park Dr Sun Prairie, WI 53590	8/1/15	7/31/18	4	2014	None
Arnie Christiansen Mason Contractors, LLC	2304 65th Dr Franksville, WI 53126	9/1/14	8/31/16	1, 2 and 4	2011	None
Atkins, Scott	*See,* Freedom Insulation, Inc					
Boecker, Roger	*See,* R-Way Pumping, Inc					
Brechtl, Mark G	*See,* Ecodec, Inc					
Cargill Heating and Air Conditioning Company, Inc	3049 Edgewater La La Crosse, WI 54603	3/1/14	2/28/17	1 and 2	2011	None

Name of Contractor	Address	Effective Date	Termination Date	Cause Code	Date of Violation(s)	Limitations/ Deviations
Castlerock Commercial Construction, Inc	PO Box 11699 Milwaukee, WI 53211-0699	2/1/12	1/31/15	1, 2 and 4	2009 & 2010	None
Christiansen, Andy	*See,* Arnie Christiansen Mason Contractors, LLC					
Christiansen, Arnold	*See,* Arnie Christiansen Mason Contractors, LLC					
Darnick, Gregory L	*See,* Darnick Trucking, LLC					
Darnick Trucking, LLC	W914 County Rd V Berlin, WI 54923	11/1/14	10/31/15	1, 2 and 4	2012 & 2013	None
Dem/Ex Group, Inc	805 S Adams St Manito, IL 61546	12/1/11	11/30/14	1 and 2	2010	None
Duran, Bernardo	*See,* A-1 Duran Roofing & Insulation Services and RRS2 Inc					
Ecodec, Inc	5106 Wintergreen Dr Madison, WI 53704	10/1/14	9/30/17	1	2011 & 2012	None
Fisher, Ed &/or Fisher, Rhonda	*See,* Dem/Ex Group, Inc					
Freedom Insulation, Inc	117925 219th Ave Chippewa Falls, WI 54729	9/1/11	8/31/14	1	2008-2010	None
Froode, Kathleen M.	*See,* Masonry Specialists II, LLC					
Galstad, Michael E (aka Michael Earl Galstad)	*See,* Cargill Heating and Air Conditioning Company, Inc					
Gjolaj, Ded	*See,* Horizon Bros Painting Corp					

Name of Contractor	Address	Effective Date	Termination Date	Cause Code	Date of Violation(s)	Limitations/ Deviations
Horizon Bros Painting Corp	1053 Kendra La Howell, MI 48843	10/1/14	9/30/16	4	2012	None
JT Roofing, Inc	350 Tower Dr Saukville, WI 53080	6/1/12	5/31/15	1, 2 and 4	2007 & 2008	None
Jinkins, Richard	*See,* Castlerock Commercial Construction, Inc					
John's Concrete	*See,* Wagner Companies, Inc., dba John's Concrete					
Kott, Joseph J.	*See,* Alpha Electric, LLC					
Masonry Specialists II, LLC	5109 Briarwood Ct Racine, WI 53402	8/1/15	7/31/18	4	2014	None
Mid-W Enterprises, Inc	1730 22nd Avenue Kenosha, WI 53140	6/1/15	5/31/17	1, 2 and 4	2013	None
Midwest Construction Co., Inc.	*See,* Mid-W Enterprises, Inc					
Oden, Cassie	*See,* A-1 Duran Roofing & Insulation Services and RRS2 Inc					
Ofstie, Darin	*See,* Precision Excavating and Grading, LLC					
Peret, Robert	*See,* A-1 Duran Roofing & Insulation Services and RRS2 Inc					

Name of Contractor	Address	Effective Date	Termination Date	Cause Code	Date of Violation(s)	Limitations/ Deviations
Precision Excavating and Grading, LLC or Precision Excavating Enterprises, LLC	2104 Pierce Saint Croix Rd Baldwin, WI 54002	5/1/11	4/30/14	1, 2 and 4	2006-2008	None
R-Way Pumping, Inc	3023 Lake Maria Rd Freeport, MN 56331	3/1/12	2/28/15	1, 2 and 4	2008	None
RRS2 Inc	133 N Jackson St, #427 Milwaukee, WI 53202 or 1313 N Franklin Pl, #805 Milwaukee, WI 53202	11/1/14	10/31/17	1, 2 and 4	2011-2012	None
Thull, Gerald T	*See,* JT Roofing, Inc					
Ventura, Robert	*See,* Mid-W Enterprises, Inc					
Wagner, Cory L.	*See,* Wagner Companies, Inc.					
Wagner Companies, Inc., dba John's Concrete	2063 Georgia Ave Racine, WI 53404	8/1/15	7/31/18	1	2013	None

Cause Code: 1 = Failure to Pay Straight Time 2 = Failure to Pay Overtime 3 = Kickback 4 = Payroll Records.

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STATE OF WISCONSIN
DWD
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PREVAILING WAGE – Contractors

Any public works project that has a total estimated project cost that equals or exceeds prevailing wage project thresholds requires a prevailing wage rate determination issued by the Department of Workforce Development (DWD). Public works include erecting, constructing, remodeling, repairing, demolishing, alterations, painting and decorating projects for a local governmental unit or state agency. State law excludes minor service or maintenance work, warranty work, or work under a supply-and-installation contract. There is a statutory definition for most of these exclusions. The prevailing wage laws that apply to local governmental units and their contractors are §§66.0903 and 103.503, Wis. Stats. The prevailing wage laws that apply to state agencies and their contractors are §§103.49 and 103.503, Wis. Stats. The applicable administrative rules for all prevailing wage projects are DWD 290 and DWD 294, Wis. Adm. Code. These laws include provisions that apply to all contractors and subcontractors working on prevailing wage projects.

Any contractor or subcontractor working on a local governmental unit or state agency's public works project that equals or exceeds current prevailing wage project thresholds must do all of the following:

- Receive and review the project's prevailing wage rate determination (i.e., white sheet).
- Tell subcontractors the project is subject to state prevailing wage law and include the prevailing wage rate determination in the construction contract, or if there is no written contract, provide a copy of the project determination to each subcontractor.
- Hire subcontractors who do *not* appear on the "Consolidated List of Debarred Contractors."
- Have a written substance abuse testing program in place that fulfills the requirements of §103.503, Wis. Stats., before commencing work on the project.

- Notify subcontractors that if DWD finds that a contractor or subcontractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.

- Apply to DWD for subjourney wage rates prior to employing these individuals on the project.

- Receive and retain a completed Affidavit of Compliance from each subcontractor brought on to the project before providing final payment to those subcontractors.

- Submit a completed Affidavit of Compliance to the contractor who brought the subcontractor on to the project before receiving final payment for the project.

- Maintain payroll records for 3 years that comply with §§66.0903(10)(a) or 103.49(5)(a), Stats. and DWD 274.06.

- Respond to requests from DWD or the project owner to provide payroll records and/or respond to prevailing wage complaints filed by employees or third parties.

For more information, visit the prevailing wage website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm. For further assistance, call the Equal Rights Division at 608-266-6861 and ask for prevailing wage.

State of Wisconsin
Department of Workforce Development
Equal Rights Division

Disclosure of Ownership

The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d), 66.0904(10)(d) and 103.49(7)(d), Wisconsin Statutes.
The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes.
Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1) (m), Wisconsin Statutes].

(1) On the date a contractor submits a bid to or completes negotiations with a state agency, local governmental unit, or developer, investor or owner on a project subject to Section 66.0903, 66.0904 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency, local governmental unit, or developer, investor or owner, the name of any "other construction business," which the contractor, or a shareholder, officer or partner of the contractor, owns or has owned within the preceding three (3) years.

(2) The term "other construction business" means any business engaged in the erection, construction, remodeling, repairing, demolition, altering or painting and decorating of buildings, structures or facilities. It also means any business engaged in supplying mineral aggregate, or hauling excavated material or spoil as provided by Sections 66.0903(3), 66.0904(2), 103.49(2) and 103.50(2), Wisconsin Statutes.

(3) This form must ONLY be filed, with the state agency project owner, local governmental unit project owner, or developer, investor or owner of a publicly funded private construction project that will be awarding the contract, if **both (A) and (B) are met**.

(A) The contractor, or a shareholder, officer or partner of the contractor:

(1) Owns at least a 25% interest in the "other construction business," indicated below, on the date the contractor submits a bid or completes negotiations; or

(2) Has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.

(B) The Wisconsin Department of Workforce Development (DWD) has determined that the "other construction business" has failed to pay the prevailing wage rate or time and one-half the required hourly basic rate of pay, for hours worked in excess of the prevailing hours of labor, to any employee at any time within the preceding three (3) years.

Other Construction Business

Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
Street Address or P O Box	City	State	Zip Code

I hereby state under penalty of perjury that the information, contained in this document, is true and accurate according to my knowledge and belief.

Print the Name of Authorized Officer			
Authorized Officer Signature	Date Signed		
Corporation, Partnership or Sole Proprietorship Name			
Street Address or P O Box	City	State	Zip Code

If you have any questions call (608) 266-6861

State of Wisconsin
Department of Workforce Development
Equal Rights Division

Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination

Authorization for this form is provided under Sections 66.0903(9)(c), 66.0904(7)(c) and 103.49(4r)(c) Wisconsin Statutes.
The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes.
Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m), Wisconsin Statutes].

This form must **ONLY** be filed with the **Awarding Agency** indicated below.

State Of)	Project Name		
	DWD Determination Number	Project Number (if applicable)	
)SS	Date Determination Issued	Date of Contract	
County Of)	Awarding Agency		
	Date Work Completed		

After being duly sworn, the person whose name and signature appears below hereby states under penalty of perjury that

- **I am** the duly authorized officer of the corporation, partnership, sole proprietorship or business indicated below and have recently completed all of the work required under the terms and conditions of a contract with the above-named awarding agency and make this affidavit in accordance with the requirements set forth in Section 66.0903(9)(c), 66.0904(7)(c) or 103.49(4r)(c), Wisconsin Statutes and Chapter DWD 290 of the Wisconsin Administrative Code in order to obtain FINAL PAYMENT from such awarding agency.
- **I have** fully complied with all the wage and hour requirements applicable to this project, including all of the requirements set forth in the prevailing wage rate determination indicated above which was issued for such project by the Department of Workforce Development on the date indicated above.
- **I have** received the required affidavit of compliance from each of my agents and subcontractors that performed work on this project and have listed each of their names and addresses on page 2 of this affidavit.
- **I have** full and accurate records that clearly indicate the name and trade or occupation of every worker(s) that I employed on this project, including an accurate record of the hours worked and actual wages paid to such worker(s).
- **I will** retain the records and affidavit(s) described above and make them available for inspection for a period of at least three (3) years from the completion date indicated above at the address indicated below and shall not remove such records or affidavit(s) without prior notification to the awarding agency indicated above.

Name of Corporation, Partnership, Sole Proprietorship, Business, State Agency or Local Governmental Unit				
Street Address	City	State	Zip Code	Telephone Number
Print Name of Authorized Officer			Date Signed	
Signature of Authorized Officer				

List of Agents and Subcontractors

Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number			Telephone Number		

If you have any questions call (608) 266-6861

State of Wisconsin
Department of Workforce Development
Equal Rights Division

Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination

Authorization for this form is provided under Sections 66.0903(9)(b), 66.0904(7)(b) and 103.49(4r)(9b), Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes.
Personal information you provide may be used for secondary purposes [Privacy Law, Section 15.04(1)(m), Wisconsin Statutes].

This form must **ONLY** be filed with the **Awarding Contractor** indicated below.

State Of _____)	Project Name	
	DWD Determination Number	Project Number (if applicable)
)SS	Date Determination Issued	Date of Subcontract
County Of _____)	Awarding Contractor	
	Date Work Completed	

After being duly sworn, the person whose name and signature appears below hereby states under penalty of perjury that

- **I am** the duly authorized officer of the corporation, partnership, sole proprietorship or business indicated below. We have recently completed all of the work required under the terms and conditions of a subcontract with the above-named awarding contractor. We make this affidavit in accordance with the requirements set forth in Section 66.0903(9)(b), 66.0904(7)(b) or 103.49(4r)(b), Wisconsin Statutes and Chapter DWD 290 of the Wisconsin Administrative Code in order to obtain FINAL PAYMENT from such awarding contractor.
- **I have** fully complied with the entire wage and hour requirements applicable to this project, including all of the requirements set forth in the prevailing wage rate determination indicated above which was issued for such project by the Department of Workforce Development on the date indicated above.
- **I have** received the required affidavit of compliance from each of my agents and subcontractors that performed work on this project and have listed each of their names and addresses on page 2 of this affidavit.
- **I have** full and accurate records that clearly indicate the name and trade or occupation of every worker(s) that I employed on this project, including an accurate record of the hours worked and actual wages paid to such worker(s).
- **I will** retain the records and affidavit(s) described above and make them available for inspection for a period of at least three (3) years from the completion date indicated above at the address indicated below and shall not remove such records or affidavit(s) without prior notification to the awarding contractor.

Name of Corporation, Partnership, Sole Proprietorship, Business, State Agency or Local Governmental Unit				
Street Address or PO Box	City	State	Zip Code	Telephone Number ( )
Print Name of Authorized Officer			Date Signed	
Authorized Officer Signature				

List of Agents and Subcontractors

Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ( )			Telephone Number ( )		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ( )			Telephone Number ( )		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
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Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ( )			Telephone Number ( )		

If you have any questions call (608) 266-6861

State of Wisconsin
Department of Workforce Development
Equal Rights Division
Labor Standards Bureau

Request to Employ Subjourneyperson

The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes.
Personal information you provide may be used for secondary purposes (Privacy Law, s. 15.04(1)(m), Wisconsin Statutes].
The employer indicated below requests that the Department of Workforce Development (DWD) determine the prevailing wage rate(s) and related qualifications to enable such employer to use a subjourneyperson(s) on the following prevailing wage project, in accordance with the provisions of Section DWD 290.025, Wisconsin Administrative Code.

1. Name of Project Appearing on the Project Determination			
County	City, Village or Town		
DWD Project Determination Number	Project Number (if applicable)		
2. Job Classification(s) for which you request a subjourney rate (i.e., carpenter, electrician, plumber, etc.)			
a.	b.		
c.	d.		
3. Employer Name (Print)	Requester Name (Print)		
Address	City	State	Zip Code
Telephone Number ( )	Requester Title		
Email address (if you prefer to receive your response via email)	Fax Number (if you prefer to receive your response via fax) ( )		

READ CAREFULLY: I understand that this request is ONLY applicable to the project and job classification(s) listed above and that subjourney employees primarily work under the direction of and assist a skilled trade employee by frequently using the tools of a skilled trade and will NOT regularly perform the duties of a general laborer, heavy equipment operator or truck driver. If the subjourney employee regularly performs the work of a different trade or occupation, he/she will be compensated for such work at the applicable journeyperson prevailing wage rate. I agree to compensate subjourney employees in strict accordance with the directions received from the DWD.

Requester Signature	Date Signed

MAIL the completed request to:
EQUAL RIGHTS DIVISION, LABOR STANDARDS BUREAU
PO BOX 8928, MADISON WI 53708
OR
FAX the completed request to: (608) 267-4592 / **DO NOT e-mail your request.**
Call (608) 266-6861 for assistance in completing this form.

ADDITIONAL GENERAL PREVAILING WAGE LAW INFORMATION

(This document updated July 2015)

NOTE: Recent prevailing wage law changes enacted by the 2015-17 Budget Bill (2015 Wisconsin Act 55) do not go into effect until calendar year 2017.

For prevailing wage laws and frequently asked questions, refer to the prevailing wage website at: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm

Topic	Who's affected?	Brief description of requirement under §66.0903 or §103.49
Non-applicability	All public entities	Prevailing wage rates do not apply to minor service or maintenance work, warranty work, or work under a supply and installation contract.
Non-applicability: Minor service or maintenance work	Local governmental units & Contractors	Minor service or maintenance work means a project of public works that is limited to • minor crack filling, chip or slurry sealing, or other minor pavement patching, not including overlays, that has a projected life span of no longer than 5 years or that is performed for a TOWN and is not funded under §86.31, regardless of projected life span; • the depositing of gravel on an existing gravel road applied solely to maintain the road; • road shoulder maintenance; • cleaning of drainage or sewer ditches or structures; or • any other limited, minor work on public facilities or equipment that is routinely performed to prevent breakdown or deterioration.
Non-applicability: Minor service or maintenance work	State agencies	Minor service or maintenance work means a project of public works that is limited to • minor crack filling, chip or slurry sealing, or other minor pavement patching, not including overlays, that has a projected life span of no longer than 5 years; • cleaning of drainage or sewer ditches or structures; or • any other limited, minor work on public facilities or equipment that is routinely performed to prevent breakdown or deterioration.
Non-applicability: Supply & installation contract	All public entities	Supply and installation contract means a contract under which the material is installed by means of simple fasteners or connectors such as screws or nuts and bolts and no other work is performed on the site of the project of public works, and the total labor cost to install the material does not exceed 20 percent of the total cost of the contract.
Non-applicability: Work which a contractor or individual donates to a public entity	All public entities	Prevailing wage laws §§66.0903 & 103.49, Stats., do not apply to work performed on a project of public works for which the local governmental unit or the state or the state agency contracting for the project is not required to compensate any contractor, subcontractor, contractor's or subcontractor's agent, or individual for performing the work.

Topic	Who's affected?	Brief description of requirement under §66.0903 or §103.49
Non-applicability: Residential	All public entities	A prevailing wage rate determination is not required for the erection, construction, repair, remodeling, or demolition of a residential property containing 2 dwelling units or less.
Non-applicability: Residential subdivision infrastructure	All public entities	A prevailing wage rate determination is not required for a road, street, bridge, sanitary sewer, or water main project that is a part of a development in which at least 90 percent of the lots contain or will contain 2 dwelling units or less, as determined by the local governmental unit at the time of approval of the development, and that, on completion, is acquired by, or dedicated to, a local governmental unit (including under §236.13(2), Stats.), or the state, for ownership or maintenance by the local governmental unit or the state.
Electronic certified payroll record	Contractors	The requirement that every contractor on a prevailing wage project submit to DWD monthly a certified record of employees who worked on the project and that DWD post these certified records on its Internet website was discontinued effective July 1, 2011. Contractors are still required to maintain payroll records and provide them upon request from DWD &/or the project owner.
Payroll record inspection request by any person	Contractors & Complainants	Any person may request DWD to inspect the payroll records of any contractor working on a prevailing wage project. On receipt of such a request, the contractor must submit to DWD a certified record of its payroll records, other than personally identifiable information relating to an employee of the contractor, for no longer than a 4-week period. DWD may request records from a contractor under this provision no more than once per calendar quarter for each project of public works on which the contractor is performing work. The department may not charge a requester a fee for obtaining that information. DWD must make these certified records available for public inspection.
Statewide uniformity	Local govern-mental units	A local governmental unit may not enact & administer a prevailing wage ordinance/provision for public works or publicly funded private construction projects. Any extant laws to that effect are void.
Substance Abuse Testing	Contractors & Workers	Before commencing work on a prevailing wage project, a contractor must have a written substance abuse testing program in place that complies with §103.503, Wis. Stats. No employee may use, possess, attempt to possess, distribute, deliver, or be under the influence of a drug or under the influence of alcohol while performing work on a prevailing wage project.

Topic	Who's affected	Brief description of requirement under §66.0903 or §103.49
Covered employees	Truck drivers & Other workers & Contractors	A laborer, worker, mechanic, or truck driver who is employed to process, manufacture, pick up, or deliver materials or products from a commercial establishment that has a fixed place of business from which the establishment supplies processed or manufactured materials or products or from a facility that is not dedicated exclusively, or nearly so, to a project of public works is NOT entitled to receive the prevailing wage rate UNLESS any of the following applies: 1) the laborer, worker, mechanic, or truck driver is employed to go to the source of mineral aggregate such as sand, gravel, or stone and deliver that mineral aggregate to the site of a project of public works by depositing the material directly in final place, from the transporting vehicle or through spreaders from the transporting vehicle. 2) the laborer, worker, mechanic, or truck driver is employed to go to the site of a project of public works, pick up excavated material or spoil from the site of the project, and transport that excavated material or spoil away from the site of the project.

NOTICE

In connection with the performance of work on this project under a contract involving funds of the State of Wisconsin Department of Natural Resources, the contractor has agreed not to discriminate against any employee or applicant for employment because of age, race, religion, color, handicap, sex, physical condition, national origin or developmental disability as defined in S.51.01 (5), Wisconsin Statutes. The contractor has also agreed to take affirmative action to ensure equal employment opportunities. These provisions apply to, but are not 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's Signature

_____

Date

SECTION 01100

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work.

B. Work by Owner.

C. Owner supplied products.

D. Contractor use of sites.

E. Work sequence.

F. Owner occupancy.

1.2 DESCRIPTION OF WORK

A. Work on the Project will be provided under a single prime contract.

B. When completed, this project will provide the Owner with a new River Bend Road Lift Station, capable of pumping up to 1,547 gpm (firm capacity).

C. The major facilities or components of the Project include, but are not limited to the following. To determine the full scope of the Project, refer to the entire Contract Documents:

1. Resurfacing and reconstruction of River Bend Road including the replacement of culvert with 56 feet of 106” by 68” concrete culvert.
2. Construction of an 18-inch interceptor sewer and a 12-inch interceptor sewer
3. Construction of a force main to the existing force main.
4. Construction of the River Bend Road Lift Station including the following:
   a. Construction of a new wet well.
   b. Construction of a new Generator/Valve Building.
   c. Installation of a new standby generator.
   d. Installation of new submersible pumps.
   e. Instrumentation and control work.
   f. Heating, ventilating and air conditioning (HVAC) work.
   g. Electrical work.
   h. Site work.
   i. Yard piping work.
   j. Selected demolition of existing facilities.
   k. Miscellaneous piping work

D. Any part or item of the work that is reasonable implied or normally required to make each installation satisfactorily operable shall be performed by the Contractor and the

expense thereof shall be included in the applicable prices bid for the work. It is the intent of these Specifications to provide the Owner with complete operable systems, subsystems, and other items of work. All miscellaneous appurtenances and other items of work that are incidental to meeting the intent of these Specifications shall be considered as having been included in the applicable prices bid for the work even though these appurtenances and items may not be specifically called for in the Specifications.

1.3 WORK BY OWNER

A. Items noted "By Owner", "Not In Contract", or "By Others" will be provided by Owner.

B. Owner's Responsibilities:
1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples, to Contractor.
2. Arrange and pay for delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, effective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:
1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

D. Products furnished to site and installed by Owner:
1. "Provided by Owner".

E. Items furnished by Owner for installation by Contractor:
1. "Owner-furnished, contractor-installed".

F. Work by Other Contractors:
1. "By Others".

1.4 CONTRACTOR USE OF SITES

A. Confine operations at sites to areas permitted by:
1. Law.
2. Ordinances.
3. Permits.
4. Contract Documents.

B. Owner will occupy the existing lift station site and maintain pumping operations. Contractor shall coordinate construction operations to allow Owner continued operation of existing lift station.

C. Assume full responsibility for protection and safekeeping of material and products stored on or off premises.

D. Move any stored material or products that interfere with operations of Owner or other Contractors.

E. Obtain and pay for use of additional storage or work areas needed for operation.

F. Time Restrictions for Performing Work: During normal weekday working hours; 7:00 AM to 5:00 PM.

G. No work shall be done between 5:00 P.M. and 7:00 A.M. nor on Sundays or legal holidays without the written permission of the Owner. However, emergency work during these hours may be done without prior permission.

H. All power outages shall be scheduled and coordinated with the Owner to minimize or avoid interruptions to lift station operations.

I. Night work may be established by the Contractor as regular procedure with the written permission of the Owner and at no additional cost to the Owner. Such permission, however, may be revoked at any time by the Owner if the Contractor fails to maintain adequate equipment and supervision for the proper execution and control of the work at night. Contractor shall provide adequate staff to respond to problems arising from the work at night. Contractor shall provide repairs as necessary to maintain plant operations. If the Contractor fails to respond in a manner deemed adequate to the Owner, the Owner reserves the right to make emergency repairs to maintain critical operations. The Owner will bill the Contractor for all labor and materials needed to affect such repairs.

1.5 WORK SEQUENCE

A. Due to potential health hazards and requirements of State of Wisconsin, DNR and U.S. EPA, existing wastewater treatment facilities must be maintained in operation during construction. Degree of pumping capacity during construction shall be equal to or exceed the capacity of the lift station before the start of construction.

B. The Contractor shall be fully responsible for providing all temporary piping, plumbing, electrical hook-ups, heating, ventilating, air conditioning, lighting, temporary structures, and related work to maintain lift station pumping operations. All details of temporary piping and temporary construction are not necessarily shown on the Drawings or covered in the Specifications. However, this does not relieve the Contractor of the responsibility to maintain wastewater pumping.

C. The Contractor shall provide a schedule and conduct his construction activities in such a manner as to allow the Owner's personnel to operate the facilities required for wastewater pumping. The Contractor shall conduct his operations in a manner necessary to minimize disturbance or disruption of lift station operations.

1. The Contractor’s construction schedule for the Work shall be as follows:
   a. Pulverize pavement on River Bend Road and 17th Avenue prior to starting road and utility work.
   b. Complete tie in of fore main at Falls Road and 17th Ave. Provide Owner with two week notice prior to commencing work. Work must be completed within 2-hours or Contractor must supply needed by-pass

pumping or hauling. Owner has the right to postpone Work due to wet weather (high flows).

c. Construct new facilities and complete startup of new equipment.

d. Place new lift station in service. Provide Owner two day notice prior to connecting to existing force main and placing the new section of sewer in service.

e. Place required plugs in existing Falls Road Sewer and abandon existing Blackhawk Valley Lift Station and existing 8-inch sewer. Provide Owner with 48 hour notice prior to starting work.

f. Complete demolition work on existing Blackhawk Valley Lift Station and existing manhole.

2. Sequence the construction of the new force main from the new lift station and its connection to the existing fore main. Coordinate the tie-in of the new force main from the new lift station to the existing force main. Provide bypass pumping and piping or hauling as needed to complete to allow for the force main construction.

3. The general sequence of construction outlined is necessary to permit efficient use of the existing facilities during construction and to expedite construction and operation of the new facilities. The general sequence includes only the work to be performed on major facilities and structures, and work required to maintain adequate plant operations.

4. The outline presented herein is intended only to identify the relationships between various construction activities required to execute the construction while maintaining lift station operations.

5. The sequence of operations shall be conducted such that sufficient wastewater pumping facilities are in service to maintain lift station operations throughout the duration of the construction.

6. The outline does not attempt to define time requirements or durations for the completion of the individual tasks. The Contractor shall be responsible for establishing the schedule for construction as specified in Section 01323, NETWORK ANALYSIS SCHEDULES.

7. The Contractor may propose an alternate sequence of activities which allows the work to occur while maintaining lift station operations, should he desire to do so. Any alternate schedules and sequences shall be subject to review and approval by the Engineer prior to implementation by the Contractor.

8. Coordinate the modification and replacement of existing equipment and structures with the Owner. Do not take any existing equipment or structure out of service without prior notification to the Owner.

D. Coordinate, schedule and make final tie-ins of new connections to existing utilities, piping, and equipment. Tie-ins shall be scheduled by the Contractor to minimize interruption of lift station operation. Contractor shall receive approval from the Owner prior to taking any existing utility or piping out of service. Provide at least 24 hours advance notice to the Owner of all proposed connections to existing piping. Tie-ins will be required for, but not be limited to electric, gas and water utilities, sanitary sewer, and wastewater piping. Contractor shall be responsible for disconnecting the piping, draining liquid from the piping if necessary, and cleanup of the area. For gas piping, Contractor shall be responsible for testing and monitoring for safe working conditions, and shall purge the piping in a safe manner prior to putting the line back in service.

E. Schedule the completion of installation of all underground piping and conduits prior to commencing surface restoration in any area.

F. Schedule modifications to existing lift station and sewer system to avoid or minimize disruptions to Owner's ongoing operations and maintenance work. In general, modifications to existing lift station and sewer system should be scheduled in the time periods described in this Section.

1.6 OWNER OCCUPANCY

A. The Owner will occupy the existing lift station sites during entire period of construction to conduct normal operations.

B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

C. Schedule the Work to accommodate this requirement.

1.7 FIELD VERIFICATION OF DRAWING INFORMATION

A. The Contractor shall field verify the size and location of existing structures, equipment, and piping depicted on the Drawings. Information on the Drawings is based upon available plant record drawings. No attempt has been made to verify the accuracy of the record drawings. Contractor shall be responsible for locating all buried pipelines and utilities prior to excavation.

1.8 ARCHAEOLOGICAL FINDS

A. Provide protection around known archeological features if shown on the Drawings. Protection shall remain in place until Final Completion.

B. Provide for the preservation and protection of materials of an archaeological nature should such materials be uncovered in the course of the Work.

C. Notify Engineer immediately upon discovery of such materials and stop work in the vicinity of the find.

D. All finds are the property of the Owner. Do not remove or disturb finds without the Owner's written authorization.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cash allowances.

B. Contingency allowances.

C. Testing and inspection allowances.

D. Schedule of values.

E. Applications for payment.

F. Change procedures.

G. Defect assessment.

H. Unit prices.

I. Alternates.

1.2 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts, delivery to site and applicable taxes.

B. Costs Not Included in Cash Allowances But Included in Contract Sum/Price: Product handling at site, including unloading, uncrating, and storage; protection of products from elements and from damage; labor for installation and finishing.

C. Architect/Engineer Responsibilities:
1. Consult with Contractor for consideration and selection of products, services, suppliers, and installers.
2. Select products and services in consultation with Owner and transmit decision to Contractor.
3. Prepare Change Order.

D. Contractor Responsibilities:
1. Assist Architect/Engineer in selection of products, services suppliers and installers.
2. Obtain proposals from suppliers and installers and offer recommendations.
3. On notification of selection by Architect/Engineer, execute purchase agreement with designated supplier and installer.

4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

E. Differences in costs will be adjusted by Change Order.

F. Allowances Schedule:
Cash Allowances – The Contractor shall include in the total base bid price for Work the following cash allowances:
1. Replacement Allowance: Replacement of existing piping, valves, wiring, conduit, and other miscellaneous materials required to incorporate the new equipment and facilities into the existing treatment plant. Note that this cash allowance shall apply only for the replacement of existing items or materials that are required to complete the work but that cannot be reused or left in place because of their condition, location, or suitability. This cash allowance shall apply only to those items that are shown or specified to be re-used, and shall not be applied to items shown or specified to be removed and replaced. This cash allowance is intended to apply only to items and materials in the existing plant whose condition, location, or suitability makes their continued use inappropriate to incorporate the new equipment and facilities into the existing lift station. **Cash allowance shall be $5,000.**
2. Skilled trades crew Allowance: Skilled trades crew to perform modifications during lift station Startup as specified in Section 01650: **Cash allowance shall be $5,000.**
3. Programing Allowance: Skilled trades crew to perform programming the existing PLC and operator interface touchscreen, and complete programming modifications to the existing SCADA system per the requirements of Section 13320: **Cash allowance shall be $8,000.**
4. Utility Allownce: Payment of the charges from gas and electric companies for extending services to new facilities to the lift station (Note: Applicable ony to charges from utility companies for providing service to the point of Owner connection): **Cash allowance shall be $10,000.**

1.3 TESTING AND INSPECTION ALLOWANCES

A. Costs Included in Testing and Inspecting Allowances: Cost of engaging testing and inspecting agency; execution of tests and inspecting; and reporting results.

B. Costs Not Included in Testing and Inspecting Allowance But Included in Contract Sum/Price:
1. Costs of incidental labor and facilities required to assist testing or inspecting agency.
2. Costs of testing services used by Contractor separate from Contract Document requirements.
3. Costs of retesting upon failure of previous tests as determined by Architect/Engineer.

C. Payment Procedures:

1. Submit copies of inspecting or testing firm's invoice with next application for payment.
2. Pay invoice on approval by Architect/Engineer.

D. Testing and Inspecting Allowances Schedule:
1. Include sum of **$10,000** for payment of testing, inspecting, and laboratory services specified in Section 01400.

E. Differences in cost will be adjusted by Change Order.

1.4 SCHEDULE OF VALUES

A. Submit printed schedule on EJCDC 1910-8-E. Contractor's standard form or electronic media printout will be considered.

B. Submit Schedule of Values in triplicate as specified in Article 2 of the General Conditions.

C. Format: Values shall be broken down by each of the major buildings or facilities as described in the Contract Document. For each of the major facilities, utilize the Table of Contents of this Project Manual to further break down the costs. Identify each line item with number and title of the major specification Section. Identify site mobilization, bonds and insurance.

D. Include a line item for the amount of Allowances specified in this section.

E. Include within each line item, direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.5 APPLICATIONS FOR PAYMENT

A. Submit three copies of each application on form EJCDC 1910-8-E. Contractor’s electronic media driven from will be considered.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Submit updated construction schedule with each Application for Payment.

D. Payment Period: Submit at intervals stipulated in the Agreement.

E. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
1. Partial release of liens from major subcontractors and vendors.
2. Record documents as specified in Section 01700 , for review by Owner which will be returned to Contractor.

3. Copies of invoices, certificates of insurance, and affidavits attesting to off-site stored products.
4. Construction progress schedules, revised and current as specified in Section 01323.

1.6 CHANGE PROCEDURES

A. Maintain detailed records of work done on a Cost of Work basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.

C. On request, provide additional data to support computations:
1. Quantities of products, labor, and equipment.
2. Taxes, insurance and bonds.
3. Overhead and profit.
4. Justification for any change in Contract Time.
5. Credit for deletions from Contract, similarly documented.

D. Support each claim for additional costs, and for work done on a Cost of Work basis, with additional information:
1. Origin and date of claim.
2. Dates and times work was performed, and by whom.
3. Time records and wage rates paid.
4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

E. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price of Contract Time by issuing supplemental instructions on a Field Order

F. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor will prepare and submit estimate within 10 days.

G. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01600.

H. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.

I. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work that are not pre-determined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.

J. Work Directive Change: Architect/Engineer may issue directive, on EJCDC 1910-8-F Work Directive Change signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

K. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

L. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

M. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

N. Change Order Forms: EJCDC 1910-8-B Change Order.

O. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

P. Correlation Of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.

1.7 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements in accordance with article 13 of the General Conditions.

B. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.

6. Loading, hauling, and disposing of rejected products.

1.8 UNIT PRICES

A. Authority: Measurement methods are delineated in individual specification sections.

B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.

C. Take measurements and compute quantities. Architect/Engineer will verify measurements and quantities.

D. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment.
   1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.
   2. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim for Contract Price adjustment.

E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.

F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Architect/Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

G. All work specified in DIVISION 1 – GENERAL REQUIREMENTS shall be considered incidental to and included in the appropriate Unit Prices stated in the Bid Form.

H. Measurement Of Quantities:
   1. Weigh Scales: Inspected, tested and certified by applicable state Weights and Measures department within past year.
   2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
   3. Metering Devices: Inspected, tested and certified by applicable State department within past year.
   4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
   5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
   6. Measurement by Area: Measured by square dimension using mean length and width or radius.
   7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.

8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.9 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option in accordance with article 9 of Instructions to Bidders. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Field engineering.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Pre-installation meetings.

G. Cutting and patching.

H. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.

F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

G. Coordinate trench excavation and backfill activities with surface restoration work.

1.3 FIELD ENGINEERING

A. Locate and protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.

B. Control datum for survey is that shown on Drawings.

C. Verify set-backs and easements; confirm drawing dimensions and elevations.

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

E. Submit copy of site drawing and certificate signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

F. Establish elevations, lines and levels. Locate and lay out instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structure.
   3. Building foundation, column locations, ground floor elevations.

G. Periodically verify layouts by same means.

H. If applicable perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Engineer prior to starting work.

I. Contractors shall sign surveyor's field notes or keep duplicate field notes and calculate and certify quantities for payment purposes.

J. Maintain complete and accurate log of control and survey work as Work progresses.

K. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

L. Promptly report to Architect/Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.

M. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.4 PRECONSTRUCTION MEETING

A. Architect/Engineer will schedule meeting after Notice to Proceed.

B. Attendance Required: Owner, Architect/Engineer, Contractor and major subcontractors.

C. Agenda:

1. Submission of executed bonds and insurance certificates.
2. Distribution of Contract Documents.
3. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
4. Designation of personnel representing parties in Contract and Architect/Engineer.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
6. Scheduling.
7. Security and housekeeping procedures.
8. Procedures for maintaining record documents.
9. Erosion control and dewatering requirements.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, project manager, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

1.6 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Architect/Engineer seven days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

E. After uncovering existing Work, assess conditions affecting performance or work.

F. Beginning of cutting or patching means acceptance or existing conditions.

G. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.

H. Provide protection from elements for areas that may be exposed by uncovering work.

I. Maintain excavations free of water.

J. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

K. Cut masonry and concrete materials using masonry saw or core drill.

L. Restore Work with new products in accordance with requirements of Contract Documents.

M. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

N. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

O. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Specifications, to full thickness of penetrated element.

P. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

Q. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new work and finishes.

G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original condition.

I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.

J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.

L. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plant without breaks, steps, or bulkheads.

M. Where change of plane of ¼ inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.

N. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.

O. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

P. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01323

NETWORK ANALYSIS SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References.

B. Quality assurance.

C. Format.

D. Schedules.

E. Submittals.

F. Review and evaluation.

G. Updating schedules.

H. Distribution.

1.2 REFERENCES

A. The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry, Washington, D.C., The Associated General Contractors of America (AGC).

1.3 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or Specialist Consultant specializing in CPM scheduling with two years minimum experience in scheduling construction work of complexity comparable to this Project, and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.

B. Contractor's Administrative Personnel: two years minimum experience in using and monitoring CPM schedules on comparable projects.

1.4 FORMAT

A. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable specification section number.

B. Diagram Sheet Size: 11 inches high x 17 inches wide.

C. Scale and Spacing: To allow for notations and revisions.

1.5 SCHEDULES

A. Prepare network analysis diagrams and supporting mathematical analyses using Critical Path Method, under concepts and methods outlined in AGC's "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".

B. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.

C. Illustrate complete sequence of construction by activity, identifying work of separate structures or facilities. Indicate dates for submittals and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.

D. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 7-day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; accrue float time to Owner and to Owner's benefit.
   11. Monetary value of activity, keyed to Schedule of Values.
   12. Percentage of activity completed.
   13. Responsibility.

E. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, of accepting revised completion dates, and recomputation of scheduled dates and float.

F. Required Sorts: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By longest float, then in order of early start.
   3. By responsibility in order of earliest possible start date.
   4. In order of latest allowable start dates.
   5. In order of latest allowable finish dates.
   6. Contractor's periodic payment request sorted by Schedule of Values listings.
   7. Listing of basic input data generating report.
   8. Listing of activities on critical path.

G. Prepare sub-schedules for each stage of Work identified in Summary of Work, Section 01100.

H. Coordinate contents with schedule of values in Price and Payment Procedures, Section 01200.

1.6 SUBMITTALS

A. Within 20 days after date of Owner-Contractor Agreement, submit proposed preliminary network diagram defining planned operations for first 60 days of Work, with general outline for remainder of Work.

B. Participate in review of preliminary and complete network diagrams jointly with Architect/Engineer.

C. Within 20 days after joint review of proposed preliminary network diagram, submit draft of proposed complete network diagram for review. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete network analysis consisting of network diagrams and mathematical analysis.

E. Submit updated network schedules with each Application for Payment.

F. Submit number of opaque reproductions Contractor requires, plus three copies Architect/Engineer will retain.

G. Submit under transmittal letter form specified in Submittal Procedures, Section 01330.

1.7 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of network diagrams and analysis with Architect/Engineer at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise network diagrams and analysis incorporating results of review, and resubmit within 10 days.

1.8 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update diagrams to graphically depict current status of Work.

C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

D. Indicate changes required to maintain Date of Substantial Completion.

E. Submit sorts required to support recommended changes.

F. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate contractors.

1.9 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Architect/Engineer, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Product data.

C. Shop drawings.

D. Samples.

E. Design data.

F. Test reports.

G. Certificates.

H. Manufacturer's instructions.

I. Manufacturer's field reports.

J. Erection drawings.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with Architect/Engineer accepted form. Submit only one specification section per transmittal.

B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and deliver to Architect/Engineer at appropriate internet File Transfer Protocol (FTP) site address. Coordinate submission of related items. Notification of submittals posted to the FTP site shall be made via e-mail.

F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

G. Submit all items in a particular specification section at the same time.

H. Provide equipment tag numbers on data sheets and product descriptions.

I. Indicate the applicable specification section, paragraph, and subparagraph numbers on the manufacturer's data sheets and product literature.

J. Clearly mark the selected product by use of arrows, underlines, or circles where more than one product is shown. Use of highlighters to identify the selected product is unacceptable. Faxed copies are not acceptable and will be rejected.

K. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

L. Allow space on submittals for Contractor and Architect/Engineer review stamps.

M. When revised for resubmission, identify changes made since previous submission.

N. Each submittal will receive up to two reviews by the Engineer at no cost to the Contractor. If a given submittal fails to reach a completed status (reviewed and marked "Approved" or Approved as Noted") on the second submittal, the Contractor shall have the costs associated with further reviews by the Engineer deducted from the Contract Amount. These costs will be computed at a rate of $100 per hour for Engineer review time.

O. Submit one (1) electronic copy, in Portable Document Format (pdf) format to the project FTP site, of all construction submittals; each copy must bear the Contractor's approval stamp and signature. A marked-up submittal with comments and disposition will be returned to the Contractor electronically via the project FTP site. Posting of reviewed submittals will be made via e-mail.

P. The Contractor shall provide one complete hardcopy set of all submittals to the Resident Engineer at the job site.

Q. The Contractor shall maintain two hard copies: one complete set of approved submittals at the job site and one complete set for Record Documents as described in Section 01700.

R. Contractor shall produce electronic submittals for product data, shop drawings, design data, test reports, certificates, manufacturer's instructions, erection drawings, and all other specific documentation required. The resolution of scanned images shall be a minimum of 300 dpi unless otherwise requested. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 8 or higher). Files shall provide a clear image with optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems transferring files. Successful searches for words or strings in the pdf documents shall demonstrate proof of OCR. Rotate pages viewed in landscape to the appropriate position for easy reading. Provide bookmarks at appropriate chapter, section, and subsection divisions. Thumbnails

shall be generated and embedded in each pdf file. Files shall be delivered without security features activated (password protected files will not be acceptable).

S. Samples should be shipped via mail to the Architect/Engineer; sample submittal review will be completed electronically.

T. Submittal file names shall include specification section plus ID tag number and .pdf file extension in accordance with Owner protocol. Individual file size shall be limited to 10 MB. File naming conventions will also include submittal revision number as appropriate.

U. Contractor shall re-process any portion of the submittal file(s) that does not view or print to Owner's satisfaction.

V. Contractor shall obtain copyright permission as required to produce electronic submittals.

W. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

X. Unrequested submittals will not be recognized or processed.

1.3 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Provide copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review distribute in accordance with Submittal Procedures article above and provide copies for record documents described in Section 01700.

1.4 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Shop drawings shall be accurate, distinct, and complete, and shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the Contract Drawings and Specifications.

D. Shop drawings shall be submitted by the Contractor. The review of such shop drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the shop drawings, and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop drawings.

E. Shop drawings include shop drawings, product data and other submittals for both shop and field-fabricated items. Submit, as applicable, the following for all prefabricated or manufactured structural, mechanical, electrical, plumbing, process systems, and equipment:

1. Shop drawings or equipment drawings, including dimensions, size and location of connections to other work, and weight of equipment.
2. Catalog information and cuts.
3. Installation or placing drawings for equipment, drives and bases.
4. Supporting calculations for equipment and associated supports specified to be designed by equipment manufacturers or suppliers.
5. Wiring and control diagrams of systems and equipment.
6. Complete manufacturer's specifications, including materials description and paint system.
7. List of special motor features being provided (i.e., space heaters, altitude corrections, thermal protectors, etc.).
8. Complete motor rating for all motors 5 HP and larger, including motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at 110 percent voltage; motor efficiency and power factor at ½, ¾, and full load at rated voltage.
9. Performance data and pump curves.
10. Suggested spare parts list with current price information.
11. List of special tools required for checking, testing, parts replacement, and maintenance (special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics).
12. List of special tools furnished with the equipment.
13. List of materials and supplies required for the equipment before and during startup.
14. List of materials and supplies furnished with the equipment.
15. Samples of finish colors for selection.
16. Special handling instructions.
17. Requirements for storage and protection before installation.
18. Requirements for routine maintenance required before plant startup.
19. List of all requested exceptions to the Contract Documents.
20. Installation instructions.

1.5 SAMPLES

A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract

Documents. Produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Samples for Selection as Specified in Product Sections:
   1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.
   3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.

F. Reviewed samples that may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

1.6 DESIGN DATA

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.7 TEST REPORT

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in duplicate.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Submittal Procedures.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Identify conflicts between manufacturer’s instructions and Contract Documents.

1.10 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit report electronically within 30 days of observation to Architect/Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

D. For equipment or product installation certifications the certificate shall state that, based on field inspection, the manufacturer’s equipment or product is properly installed, lubricated, and ready for start-up and operation. The certificate shall be signed by an authorized representative of the manufacturer.

1.11 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.12 ADDITIONAL SUBMITTAL REQUIREMENTS

A. Refer to individual specification sections for additional submittal requirements. Conform to requirements specified herein and those additional requirements when preparing submittals under this section

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.

B. Tolerances

C. References.

D. Mock-up requirements.

E. Testing and inspection services.

F. Manufacturers' field services.

G. Examination.

H. Preparation.

1.2 QUALITY CONTROL AND 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.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect/Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Owner will employ services of an independent firm to perform testing and inspection. Contractor shall pay for services from cash allowances specified in Section 01200.

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.

D. Reports will be submitted by independent firm to Architect/Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

H. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Architect/Engineer.
   7. Attend preconstruction meetings and progress meetings.

I. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer and to Contractor. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.
   10. Conformance with Contract Documents.

J. Limits On Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and certification of proper installation as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Refer to Section 01330 - SUBMITTAL PROCEDURES, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01445

MANUFACTURER'S FIELD SERVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General.

B. Installation.

C. Performance Testing and Start-up.

D. Operator training.

1.2 GENERAL

A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services due to equipment malfunction or other problem, such time shall be at the expense of the manufacturer, supplier, or Contractor as applicable, with no change in Contract Price.

B. "Days" specified shall consist of 8 hour days on-site, excluding travel time.

C. The Contractor shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of the Engineer and Owner. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers in sufficient time to assure their compliance with the service requirements.

1.3 INSTALLATION

A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems as many days as may be necessary to ensure proper installation and to resolve assembly or installation problems at the work site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers of all equipment furnished, whether or not specifically set forth in the Specifications.

B. Where a manufacturer's certificate is called for in the Specifications, the manufacturer's representative shall provide the attached certificate stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable safety equipment has been properly installed, and that the proper electrical and mechanical connections have been made. This certification shall be provided to the Engineer prior to the start-up.

C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for plant start-up.

D. Submittals shall be in accordance with Submittal Procedures, Section 01330.

1.4 PERFORMANCE TESTING AND START-UP

A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary due to any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.

B. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by the Owner for full-time operation.

C. Start-up of equipment and plant shall be in accordance with Manufacturer's instruction and Section 01650, Starting of Systems.

1.5 OPERATOR TRAINING

A. Where training is called for in the Specifications, provide competent and experienced technical representative to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include prestart-up classroom instruction and start-up on-site instruction, as stated in Specifications.

B. The Contractor shall coordinate the prestart-up training periods with Owner’s operating personnel and manufacturers' representatives.

C. Post start-up operator training shall be as requested by the Owner any time during the one year warranty period.

D. All prestart-up training shall be completed 14 days prior to actual plant start-up.

E. Operating training shall be in accordance with Section 01650.

F. The Owner or Engineer shall have the right to videotape or otherwise electronically or photographically record all training sessions.

G. Contractor shall provide attached Certificate of Operator Training cosigned by Owner and supplier's representative, verifying training accomplished to satisfaction of all parties.

H. Operation and maintenance manual submitted in accordance with Section 01730, Operation and Maintenance Manuals, shall be approved prior to scheduling prestart-up operator training.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

CERTIFICATE OF PROPER INSTALLATION

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

This form shall be completed and submitted to Architect/Engineer prior to plant start-up.

CERTIFICATE OF OPERATOR TRAINING

Project _____

Equipment _____

Specification Section _____

Contract _____

I hereby certify the equipment supplier/manufacturer has instructed Owner's personnel in the start-up operation and maintenance of this equipment as required in the specifications.

MANUFACTURER'S REPRESENTATIVE

Signature _____ Date _____

Name (print) _____

Title _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

OWNER

I hereby certify that my operating personnel received ____ days instruction from_____for start-up, operation, and maintenance of this equipment.

Signature _____ Date _____

Name (print) _____

Title _____

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
1. Temporary electricity.
2. Temporary lighting for construction purposes.
3. Temporary heating.
4. Temporary ventilation.
5. Telephone service.
6. Facsimile service.
7. Temporary water service.
8. Temporary sanitary facilities.

B. Construction Facilities:
1. Field offices and sheds.
2. Vehicular access.
3. Parking.
4. Progress cleaning and waste removal.
5. Project identification.
6. Traffic maintenance.

C. Temporary Controls:
1. Barriers.
2. Enclosures and fencing.
3. Protection of the Work.
4. Security.
5. Water control.
6. Dust control.
7. Erosion and sediment control.
8. Pollution control.

D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Use existing power service at the existing treatment plant.

B. Owner will pay cost of electrical energy used for construction. Exercise measures to conserve energy.

C. Provide main service disconnect, over current protection, distribution and receptacles at convenient locations.

D. Permanent power supply and convenience receptacles may be utilized during construction.

E. Replace any components damaged during construction.

F. Complement existing power service capacity and characteristics as required for construction operations.

G. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for safe construction operations as required.

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.

C. Maintain lighting and provide routine repairs.

1.4 TEMPORARY HEATING

A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

B. Enclose building prior to activating temporary heat in accordance with Enclosures article in this section.

C. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

D. Maintain minimum ambient temperature of 50 to 60 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.6 TELEPHONE SERVICE

A. Contractor’s field supervisor and project manager shall have cellular telephone service for communications with the Architect/Engineer's and the Owner.

1.7 INTERNET / FACSIMILE SERVICE

A. Not used.

1.8 TEMPORARY WATER SERVICE

A. Provide and pay for suitable quality water service for potable uses.

B. Water service is not available at the site. Provide and pay for cost of temporary water needed to maintain specified conditions for construction operations.

1.9 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide facilities at time of project mobilization.

1.10 VEHICULAR ACCESS

A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.

B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

C. Continuous access to existing wet well and lift station must be provided at all times. Notify the Owner at least 48 hours prior to taking any roadway section out of service.

D. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

E. Provide unimpeded access for emergency vehicles.

F. Provide and maintain access to fire hydrants free of obstructions.

G. Provide means of removing mud from vehicle wheels before entering streets.

H. Brush roads clean as requested by Owner or Engineer, minimum weekly.

1.11 PARKING

A. Provide temporary gravel surface parking areas to accommodate construction personnel.

B. Locate as indicated on Drawings or as directed by the Owner.

C. When site space is not adequate, provide additional off-site parking.

D. Use of existing on-site streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.

E. Use of existing parking facilities by construction personnel is not permitted.

F. Do not allow heavy vehicles or construction equipment in parking areas.

G. Do not allow vehicle parking on existing pavement.

H. Permanent Pavements and Parking Facilities:
   1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
   2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

I. Maintenance:
   1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

J. Removal, Repair:
   1. Remove temporary materials and construction at Substantial Completion.
   2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
   3. Repair existing facilities damaged by use, to original condition.

K. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.12 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Maintain existing plant roadways clean of mud and debris.

C. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.

D. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

E. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

F. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13 PROJECT IDENTIFICATION

A. No signs will be allowed without Owner permission, except those required by law.

1.14 TRAFFIC MAINTENANCE

A. Through Traffic Access.

1. The Contractor shall maintain a minimum of one lane of traffic on streets at all times. Roads shall be maintained in a safe condition throughout the duration of the project. The Contractor shall take all precautions necessary to safely warn the public of the probable increased danger to travel due to construction of the Work.
    a. All streets shall be open to traffic after working hours and all day on weekends and holidays.
    b. The Contractor shall at all times conduct his work in a manner to minimize obstruction to local traffic.
    c. The Contractor shall inform all business owners on the last day of the previous week his intention for work to be performed the following week so as that the owners may schedule deliveries, etc. in advance without adverse impacts to their business.

B. Driveway Access.
1. If driveway access is to be blocked, then it shall be the Contractor's responsibility to notify affected property owners prior to closing that section of the street to traffic.
2. The Contractor shall construct temporary ramps at all driveways to provide access during construction. The cost of temporary ramps shall be incidental to common excavation of the street.

C. Access to Businesses and Industries.
1. The Contractor shall provide full-time access to businesses and industries unless other satisfactory arrangements are made with the affected property prior to commencing the work. Access may be provided by constructing temporary drives that shall be considered incidental to the cost of other items. Access cannot be closed on and portion of two consecutive days to any property within the project limits.

D. Mail delivery.
1. The Contractor is responsible for insuring that mail can be delivered to properties affected by his work operations in a reasonable and timely manner.
2. If the Contractor's operations unduly restrict or prohibit mail delivery, he shall take measures to provide alternate method(s) for mail pick-up.

E. Signing, Barricades and Flag Persons.
1. Whenever the Contractor's activities obstruct through traffic, there shall be sufficient flag persons on duty to guide the traffic, and the Contractor shall furnish and install all temporary signing and barricades required to safely direct the traveling public around the obstructed area.
    a. As a minimum, suitable barriers shall be erected and maintained at each end of the obstructed section of roadway and at all affected roadway intersections.
    b. All signing and barricades shall be done in accordance with the latest revision of Part VI, Traffic Controls for Construction and Maintenance Operations of the Wisconsin Manual of Traffic Control Devices, the Traffic Control Plan (if required by the Owner) and Section 643 of the State Specifications.

1.15 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.16 ENCLOSURES AND FENCING

A. Construction: Contractor's option.

B. Provide 7 feet high fence around construction site; equip with vehicular and pedestrian gates with locks.

C. Exterior Enclosures:
1. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.17 SECURITY

A. Security Program:
1. Protect Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
2. Initiate program in coordination with Owner's existing security system at project mobilization.
3. Maintain program throughout construction period until Owner occupancy.

B. Entry Control:
1. Restrict entrance of persons and vehicles into Project site and existing facilities.
2. Allow entrance only to authorized persons with proper identification.
3. Maintain log of workers and visitors, make available to Owner on request.
4. Owner will control entrance of persons and vehicles related to Owner's operations.

1.18 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.19 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.20 EROSION AND SEDIMENT CONTROL

A. General: Comply with the rules and policies promulgated or developed pursuant to Section 281.33 of the Wisconsin Statutes, conditions of Section NR 216 subchapter III, conditions of Section NR 110.15 (5) (n) of the Wisconsin Administrative Code, and the procedures outlined in the Storm Water Construction and Post-Construction Technical Standards, as published by the Wisconsin Department of Natural Resources, "Construction Site Erosion & Sediment Control".

B. General Erosion Control Measures:
1. Contractor shall follow the WDNR Storm Water Construction and Post-Construction Technical Standards for installation and maintenance of erosion control devices during construction (located on the WDNR website: http://dnr.wi.gov/runoff/stormwater/techstds.htm).
2. Provide the erosion control measures shown on the Erosion Control Plan in the Drawings.
3. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
4. Minimize surface area of bare soil exposed at one time.
5. Provide temporary measures including berms, dikes, and drains, and other devices to divert stormwater away from disturbed or exposed areas. Provide temporary sedimentation basins as shown on the Drawings.
6. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
7. Fertilizers and pesticides shall not be used in channel and swale areas.

C. General Maintenance Requirements:
1. Contractor shall conduct erosion and sediment control Best Management Practice inspections and submit maintenance logs on a weekly basis. The log and the weekly written reports of all inspections conducted shall be maintained by the Contractor at the construction site. Logs shall include the following information:
   a. Date of each inspection
   b. Name of Inspector
   c. Construction activity phase at date of inspection
   d. Description of findings during inspection
   e. Description of repairs or other actions undertaken
   f. List of needed actions and completion dates
2. All erosion control and storm water management practices will be checked for stability and operation every seven (7) days and within twenty-four (24) hours of any storm event producing at least 0.5 inches of rainfall. Any required repairs or replacements shall be made immediately within 24 hours of inspection or notification shall be made to the Department of Natural Resources (DNR).

3. All seeded areas, including ditches, shall be reseeded and mulched as necessary according to project specifications and plan practices to maintain a vigorous, dense vegetative cover.
4. Any drainage ditches experiencing excessive erosion and channel degradation due to high runoff volumes shall be re-graded and covered with biodegradable erosion control matting. Installation shall be per specifications for erosion control matting and manufacturer's recommendations.
5. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

D. Silt Fence:
1. A temporary sediment barrier consisting of a geotextile filter fabric stretched across and attached to supporting posts and entrenched.
2. Install in accordance with the contract drawings, and as located on the drawings, prior to disturbing the upslope area.
3. Remove after the disturbed area is stabilized by established seeding.
4. Silt fence filter fabric shall meet the requirements of WDNR Conservation Practice Standard 1056 and Section 628 of the State Specifications.
5. Maintenance:
   a. Repair or correct any damaged or decomposed fences, undercutting, or flow channels around the end of barriers.
   b. Dispose of sediment deposits that reach ½ the height of the fence.

E. Erosion Control Mat:
1. A manufactured blanket or mat made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, with a plastic or biodegradable mesh on one or both sides.
2. Products: Only mats listed in the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be used.
3. Erosion control mats shall meet the requirements of WDNR Conservation Practice Standards 1052 and 1053 and Section 628 of the State Specifications.
4. Install as located on the drawings and specified herein.
   a. The mat shall be installed after all topsoiling, fertilizing, liming and seeding is complete.
   b. Erosion mats shall extend for whichever is greater: upslope one-foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.
   c. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.
   d. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.
5. Maintenance:
   a. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per

manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

b. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

c. Maintenance shall be completed as soon as possible with consideration to site conditions.

F. Crushed Stone Tracking Pad

1. A stabilized pad of aggregate located at a point where traffic will egress a construction site.
2. Install (if necessary) as directed by Village or Engineer
3. Material and installation shall comply with WDNR Conservation Practice Standard 1057.
4. If there are signs that the installation is ineffective, additional stone or re-construction may be required as directed.
5. Cost shall be incidental to Section 1 work items.

G. Inlet Protection

1. A temporary device installed in or around a storm inlet.
2. Install in existing inlets where construction runoff is anticipated. In new installations, install immediately following inlet installation.
3. Material and installation shall comply with WDNR Conservation Practice Standard 1060.
4. Cost shall be incidental to Section 1 storm sewer items.

H. Ditch Checks

1. A temporary dam constructed across a swale to reduce flow velocities.
2. Install as indicated on the project plans.
3. Material and installation shall comply with WDNR Conservation Practice Standard 1062.
4. If there are signs that the installation is infective, the ditch checks will be replaced by the contractor at no additional cost to the owner.
5. Cost of ditch checks shall be at the unit price bid on the bid form.

1.21 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

C. Comply with all laws prohibiting the pollution of any lake, stream, river, or wetland by the dumping of any refuse, rubbish, dredge material, or debris therein.

D. Disposal of materials into any waters of the State must conform with the requirements of a Chapter 30 permit from the Wisconsin Department of Natural Resources, and a Section 404 permit from the U.S. Army Corps of Engineers. These permits if required will be obtained by the Owner and provided to the Contractor for posting on the job site.

1.22 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion.

B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary field offices and sheds.

B. Maintenance and cleaning.

C. Removal.

1.2 USE OF EXISTING FACILITIES

A. Existing facilities shall not be used for field offices or for storage.

1.3 USE OF PERMANENT FACILITIES

A. Permanent facilities shall not be used for field offices or for storage.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove at completion of Work.

C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.

D. Exterior Materials: Weather resistant, finished in one color acceptable to Owner.

E. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.

F. Lighting for Offices: 50 ft-C at desk top height, exterior lighting at entrance doors.

G. Fire Extinguishers: Appropriate type fire extinguisher at each office and each storage area.

H. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

2.3 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfortable conditions. 70 degrees F heating and 72 degrees F cooling.

B. Storage Spaces: Heating and ventilation as needed to maintain Products in accordance with Contract Documents; adequate lighting for maintenance and inspection of Products.

2.4 CONTRACTOR OFFICE AND FACILITIES

A. Size: For Contractor's needs and to provide space for project meetings.

B. Telephone and Fax: As required for Contractor's needs. Contractors shall pay for service installation and monthly phone bills.

C. Furnishings in Meeting Area: Conference table and chairs to seat at least 10 persons; racks and files for Contract Documents, submittals, and project record documents.

D. Other Furnishings: Contractor's option.

E. Equipment: Six adjustable band protective helmets for visitors, one 10 inch outdoor weather thermometer.

2.5 ENGINEER'S OFFICE

A. General Contractor shall provide a separate trailer or a separate space in the Contractor’s trailer for sole use of Engineer, with separate entrance door with new lock and four keys.

B. Area: Minimum 100 sq ft, minimum dimension 8 ft for office.

C. Windows: Minimum two with minimum total area of 15 percent of floor area, with operable sash and insect screens. Locate to provide views of construction area.

D. Minimum four 110 volt duplex convenience outlets, one on each wall.

E. Sanitary Facilities: Convenient access to private lavatory toilet facilities.

F. Drinking water: Bottled water service/dispenser in trailer.

G. Furnishings:
1. One 60 x 30 desk 3 double pedestal with five drawers plus center drawer, and lamp.
2. Plan rack with 12 hangers to hold working Drawings, shop drawings, and record documents.

3. Two standard four-drawer legal - size metal filling cabinet with locks and two keys per lock.
4. One swivel arm chairs.
5. Four straight chairs.
6. One waste basket.

2.6 STORAGE AREAS AND SHEDS

A. Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01600.

PART 3 EXECUTION

3.1 PREPARATION

A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.2 INSTALLATION

A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.

B. Parking: Contractor shall provide two parking spaces as specified in Section 01500 for use by the Engineer, connected to office by walk.

C. Employee Residential Occupancy: Not allowed on Owner's property.

D. Provide temporary services required for field offices as specified in Section 01500.

3.3 MAINTENANCE AND CLEANING

A. Contractor shall provide weekly janitorial services, cleaning, trash removal and maintenance for Engineer’s office, Contractor’s office and storage areas.

B. Contractor shall maintain approach walks free of mud, water, and snow.

3.4 REMOVAL

A. At completion of Work, Contractor shall remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

J. Perform all of the manufacturer's short term and long term storage requirements, including maintenance procedures such as lubrication and equipment rotation.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Architect/Engineer will consider requests for Substitutions only within 30 days after date established in Notice to Proceed.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Starting equipment and systems.

B. Operator training.

C. Plant start-up.

D. Testing, Adjusting and Balancing.

1.2 STARTING EQUIPMENT AND SYSTEMS

A. Startup: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Startup process encompasses and coordinates system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training, and verification of actual performance.

B. Provide a schedule for start-up for each new system or facility. Schedules shall conform to Section 01323 and shall provide sufficient detail for a logical sequence of tasks leading to start-up. Start-up schedule shall be submitted to Architect/Engineer 30 days prior to start-up.

C. Coordinate schedule for start-up of various equipment and systems.

D. Notify Engineer seven days prior to start-up of each item.

E. Conduct progress startup meetings throughout construction, to plan, scope, coordinate, schedule future activities and resolve problems.

F. Verify that all O&M manuals have been submitted and approved in accordance with Section 01730.

G. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions that may cause damage.

H. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

I. Verify wiring and support components for equipment are complete and tested.

J. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions.

K. Require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

L. Submit a written report in accordance with Section 01445 that equipment or system has been properly installed and is functioning correctly.

1.3 OPERATOR TRAINING

A. Operator training shall conform to the requirements of Section 01445.

B. Demonstrate operation and maintenance of equipment and products to Owner's personnel at least 14 days prior to start-up.

C. Demonstrate Project equipment and instruct in a classroom environment located at the treatment plant and instructed by a manufacturers' representative who is knowledgeable about the Project.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at designated location.

G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

H. The amount of time required for operator training on each item of equipment and system is that specified in individual sections.

1.4 LIFT STATION START-UP

A. Wastewater Start-up Period:
   1. The Wastewater Start-up Period shall not commence until:
      a. Manufacturer's Certificates of Proper Installation have been provided for all installed equipment.
      b. Pipeline pressure tests have been completed.
      c. Equipment has been lubricated in conformance with the manufacturer's recommendations.
      d. All functional testing has been completed.
      e. All performance testing has been completed, except for testing that the Engineer accepts to be performed during the Wastewater Start-up Period.
      f. The process instrumentation and control systems (all of Division 13 requirements) Operational Readiness Test has been substantially completed and documented.

g. All tests, adjustments, and settings have been performed on electrical equipment.

h. All operations and maintenance manuals have been approved by the Engineer.

2. Start-up of the new facilities with wastewater includes coordinated operation of the facilities by the Contractor, his subcontractors, Owner-operating personnel, and manufacturer's representatives for equipment items and systems.

3. The Contractor shall provide the following services.

   a. Provide the coordinated services of all subcontractors and equipment suppliers to correct any and all observed and experienced deficiencies in the specified services completed or yet to be performed.

   b. Complete testing on specified items, such as pumps, and coordinate with the Owner's operation of such equipment.

   c. Complete the instrumentation system functional acceptance test.

   d. Provide the services of a project superintendent to manage any contract change orders during start-up.

4. The Contractor shall designate and provide one or more persons to be responsible for coordinating and expediting his start-up duties. The person or persons shall be present during all prestart-up meetings and shall be available to the Owner's personnel at all times during the wastewater start-up period.

5. Where start-up services are called for in the Specifications, the Contractor shall supply and coordinate the specified manufacturers' services for the start-up period.

6. The Contractor shall conduct performance tests on all equipment, systems, and subsystems not previously tested and approved by the Engineer.

7. The Contractor shall be responsible for adjustments, repairs, and corrections of specified work.

8. The Owner will provide and pay for the necessary electrical service and gas service used during the wastewater start-up and operation periods.

9. Following the successful start-up of lift station facilities on wastewater, the Owner will assume full responsibilities for all operations, maintenance and process adjustments. The Contractor, subcontractors, and equipment manufacturer(s) shall only be responsible for specified warranty work, uncompleted work and remaining training services.

10. Provide skilled trades crew for performance of work as directed by the Engineer during startup. This work is in addition to the Contractor’s specified responsibilities, and will be paid for from the Allowances. Contractor shall have prior approval from the Engineer prior to performing work under this allowance.

11. Successful completion of Startup is required prior to Substantial Completion.

1.5 TESTING, ADJUSTING AND BALANCING

A. Contractor will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.

B. Independent firm will perform services specified in Division 15.

C. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Adjusting.

D. Project record documents.

E. Operation and maintenance data.

F. Warranties.

G. Spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES

A. 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 inspection.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit final Application for Payment as specified in the GENERAL CONDITIONS identifying total adjusted Contract Price, previous payments, and amount remaining due. Included with the final Application for payment shall be the following written certifications:
   1. Final waiver of liens from Contractor, all subcontractors and all material and equipment suppliers.
   2. Contractor's affidavit of release of liens.
   3. Consent of surety for final payment.
   4. Contractor's affidavit of payment.
   5. Affidavit of compliance with wage rate determination in accordance with Division 0.

1.3 FINAL CLEANING

A. Final cleaning as specified in Section 01710 - Cleaning.

1.4 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

A. Project Record Documents are to be submitted as specified in Section 01720 - Project Record Documents.

1.6 OPERATION AND MAINTENANCE DATA

A. Operation and maintenance data are to be submitted as specified in Section 01730 - Operation and Maintenance Data.

1.7 WARRANTIES AND BONDS

A. Provide notarized copies.

B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three ring binder with durable plastic cover.

D. Submit to Engineer for approval prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment. Fill out and submit to the Owner the attached Spare Parts Transfer Form for each parcel of spare parts delivered.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

Spare Parts Transfer Form

Owner: _____ Contract:_____
Project: _____ Contractor: _____

Spec. Section	Quantity	Item Description	Part No.

The above listed Spare Parts submitted by _____
(Contractor)

under Contract _____, have been inspected and inventoried, and are hereby accepted, subject to all contract provisions, by the _____
(Owner)

Signature:_____
(Owner Representative)

Title:_____

CC: Engineer
Contractor

Date:_____

SECTION 01710

CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of existing facilities to be modified.

B. Cleaning during construction.

C. Dust control.

D. Final cleaning.

1.2 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.1 MATERIALS

A. Use only those cleaning materials that will not create hazards to property or damage surfaces of material to be cleaned.

PART 3 EXECUTION

3.1 CLEANING OF EXISTING STRUCTURES TO BE DEMOLISHED

A. Owner will empty tank contents and clean wastewater residues and solids from all tank walls, tank floors, and piping prior to Contractor commencing work. Structures requiring cleaning prior to demolition include the following:
   1. Existing Blackhawk Valley Lift Station Wet Well
   2. Existing manhole on abandoned 8” sewer (Drawing 26-R-1).

3.2 CLEANING OF EXISTING FACILITIES TO BE MODIFIED

A. Contractor shall clean wastewater residues and solids from all tank walls, tank floors, and piping prior to beginning construction. Existing structures requiring cleaning prior to modifications include the following:
   1. Existing sanitary sewers, manholes and force mains.

B. Contractor to provide additional cleaning as required for proper construction.

C. Flush and drain all piping to be modified prior to construction.

D. Dispose of all solid waste in an approved landfill.

3.3 DURING CONSTRUCTION

A. Execute periodic cleaning to keep Work, site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris resulting from construction operations.

B. Provide on-site containers for collection and removal of waste materials, debris, and rubbish in accordance with applicable regulations. Remove weekly and dispose of off-site.

C. Thoroughly clean all spilled dirt, gravel, or other foreign material caused by the construction operations from all streets and roads at the conclusion of each day's operation.

D. Provide daily cleaning of facilities in use by the Owner when construction dust, mud or debris interfere with the Owner’s operations.

E. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

F. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

3.4 DUST CONTROL

A. Clean interior space prior to start of finish painting and continue cleaning on as-needed basis until painting is completed.

B. Schedule operations so dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.

C. Give all roads and haul roads used in the construction area an approved dust-preventive treatment or daily watering when requested by the Engineer to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

3.5 FINAL CLEANING

A. Employ skilled workers for final cleaning.

B. Execute final cleaning prior to final inspection.

C. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Clean all interior walls, ceilings, floors, cabinets, and furniture.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Wash and shine glazing and mirrors.

G. Polish glossy surfaces to clear shine.

H. Ventilating Systems:
   1. Clean permanent filters and replace disposable filters if units were operated during construction.
   2. Clean ducts, blowers, and coils if units were operated without filters during construction.

I. Electrical Systems:
   1. Leave electrical equipment rooms broom clean.
   2. Clean interior of panel cabinets, pull boxes, and other equipment enclosures.
   3. Wash and wipe clean lighting fixtures, lamps, and other electrical equipment that may have become soiled during installation.
   4. Touch-up paint and repaint, if deterioration is extensive, electrical items delivered to job with finish coat of paint.

J. Clean debris from roofs, gutters, down spouts, and drainage systems.

K. Clean site; sweep paved areas, rake clean landscaped surfaces.

L. Remove waste and surplus materials, rubbish and construction from the site.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Maintenance of Documents and Samples.

B. Record Documents.

C. Submittals.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain at site, one copy of the following Record Documents:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change orders and other modifications to Contract.
5. Field orders, written instructions, or clarifications.
6. Approved submittals.
7. Field test records.
8. Construction photographs.
9. All associated permits.
10. Certificates of inspection and approvals.

B. Store documents and samples in Contractor's field office on-site apart from documents used for construction:
1. Provide files and racks for storage of documents.
2. Provide secure storage space for storage of samples.

C. Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

D. Make documents and samples available at all times for inspection by Engineer.

E. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

1.3 RECORD DOCUMENTS

A. Maintain record set of drawings and specifications legibly changed to transfer approved modifications in completed Work that differ from Contract Documents.

B. Label each document "Project Record" in neat, large printed letters.

C. Record information concurrently with construction progress.

1. Do not conceal any work until required information is recorded.
2. Record changes made by Written Amendment, Field Order, Change Order, or Work Directive Change.

D. Specifications: Legibly mark and record at each section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

E. Drawings:
1. General:
a. All finished manhole rim and invert elevations, as well as sanitary and storm sewer invert elevations in structures and outfalls.
b. Depths of various elements of foundation in relation to finish first floor datum.
c. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
d. Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
e. Field changes.
f. Details not on original Drawings.
g. Location and identification of exposed interior piping.
2. Electrical:
a. Horizontal and vertical locations and size of underground cable, conduit, and duct runs dimensioned from established building lines.
b. Plan location and size of interior concealed and exposed feeders.
c. Size and location of access panels.
d. Departures from original drawings and electrical work revisions.

1.4 SUBMITTALS

A. At Substantial Completion:
1. Deliver one marked up set of Record Documents to Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance.

B. Format.

C. Contents, each volume.

D. Manual for materials and finishes.

E. Manual for equipment and systems.

F. Submittals.

1.2 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.3 FORMAT

A. Prepare data in the form of an instructional manual.

B. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

C. Cover: Identify each binder on the cover and spine with typed or printed title OPERATION AND MAINTENANCE MANUAL; list title of Project and subject matter of contents.

D. Provide a Title Page that provides the following information:
1. Title: OPERATIONS AND MAINTENANCE MANUAL
2. Title of project: As shown on the Contract Documents
3. Engineer name, address, telephone number and web site.
4. General Contractor name, address, telephone number and web site.

E. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

F. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment. All tabs shall be legible with permanent smudge resistant lettering.

G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper. Manufacturer's printed data, must be originals or copies of good quality and clearly legible. Fax copies of material are not acceptable and will be rejected.

H. Drawings 11 X 17 inch or smaller: Provide with reinforced punched binder tab. Bind in with text; fold 11 x 17 inch drawings to size of text pages.

I. Drawings larger than 11 X 17 inch: Provide clear plastic holder the size of the test pages, punched and bound in binder with the enclosed folded drawing.

1.4 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; name of equipment or product as described in the Contract Documents, specification number and title. Provide schedule of products and systems, indexed to content of the volume and arranged in a logical systematic order and shall as a minimum include each tabbed divider.

B. For Each Product or System: List names, addresses, telephone numbers and web sites of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information. Clearly mark the selected product by use of arrows, underlines, or circles where more than one product is shown. Use of highlighters to identify the selected product is unacceptable.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

E. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01400.

1.5 MANUAL FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: As specified in individual product specification Sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.6 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, complete nomenclature and commercial number of replaceable parts, complete nameplate data, and P&ID numbers as set forth in the Drawings.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications.

C. Include color-coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions. Include suggested maintenance requirements for optimal performance.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed. These shall be ladder diagrams, instrument loop diagrams, and electrical schematics as appropriate.

K. Provide Contractor's coordination drawings, with color-coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to P&ID numbers as set forth in the Drawings.

M. Provide list of original manufacturer's spare parts, predicted life, current prices, and recommended quantities to be maintained in storage.

N. Bill of material.

O. Completed typewritten equipment data form included with this section. Manufacturer's standard form will not be acceptable.

P. Manufacturer's safety instructions.

Q. Include test and balancing reports as specified in Division 15.

R. Additional Requirements: As specified in individual product specification Sections.

S. Provide a listing in Table of Contents for design data, with tabbed flysheet and space for insertion of data.

1.7 SUBMITTALS

A. Submit four copies for review within 60 days after time Contractor receives approved Shop Drawings for equipment/systems from Engineer.

B. Progress payments for equipment delivered, stored, or installed under these Contract Documents will not be made beyond 50% of the scheduled value until copies of the O&M data are delivered to and approved by Engineer. Progress payments for control systems packaged with equipment will not be made beyond 50% of the scheduled value until O&M data revisions are incorporated into equipment and control system manuals delivered and approved by Engineer.

C. Operation and maintenance manual submittals shall be accompanied by the checklist attached to this section indicating that the requirements of this section have been met in its entirety. Engineer will reject submittals without completed checklist. Pages for all submittals shall be numbered.

D. Engineer's review and acceptance of operation and maintenance manuals will be only for conformance with requirements of this section, for form of submittal and organization of data and completeness of information provided, but not for technical content or coordination between individual suppliers of equipment or system(s).

E. Provide four hard copies of the final approved O&M manuals and one electronic version as described herein.

F. Contractor is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. The Contractor shall provide all Equipment O&M Manuals in the electronic format as described herein.

G. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XXXXX_YY.PDF) where XXXXX is the specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems

require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename. (Example: 19876_01a.pdf).

H. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.

I. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document form (*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by Engineer. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 8 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.

J. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.

K. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter", "Section", "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of Engineer. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.

L. Thumbnails shall be generated and embedded in each PDF file.

M. Files shall be delivered without Security features activated. Password protected files will be unacceptable.

N. The opening view for PDF files shall be set as follows:
1. Initial View: Bookmarks and Page
2. Magnification: Fit In Window
3. Page Layout: Single Page

O. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.

P. The submittal shall be delivered on CD after all Equipment O&M Manuals have been received and approved. Each CD shall be labeled, at a minimum, as follows, including: 1) CD-ROM disks, 2) jewel cases, and 3) hard copies.
1. Manufacturer name, point of contact, telephone number, facsimile number, and e-mail address as appropriate
2. Equipment name and/or O&M title spelled out in complete words
   a. Example: “Operations and Maintenance Manual - Horizontal Centrifugal Nonclog Pumps”

3. Specifications section number
4. Project name
5. Date and File Name: Example "12-20-07", "19876_01.pdf"

Q. Contractor shall reprocess any portion of the document that does not view or print to Owner's satisfaction.

R. Contractor shall obtain all copyright permissions associated with conversion of O&M manual information into electronic format.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

EQUIPMENT DATA FORM (Page 1 of 3)

PROJECT NAME _____

CONTRACT NO. _____

CONTRACTOR _____

EQUIPMENT NO. _____

DESCRIPTION _____

LOCATION _____

MANUFACTURER _____

PURCHASED FROM _____ PURCHASE DATE _____

VENDOR ORDER NO. _____ PURCHASE PRICE _____

LOCAL SUPPLIER _____ PHONE _____

ADDRESS _____

MODEL NO. _____ SHIPPING WT/UNIT _____

NO. OF UNITS _____ SERIAL NOS. _____

NAMEPLATE DATA

ELECTRIC MOTOR	PUMP/HVAC UNIT	DRIVE/REDUCER	OTHER (I&C)
MANUFACTURER:	MANUFACTURER:	MANUFACTURER:	MANUFACTURER:
_____	_____	_____	_____
TYPE: []AC []DC	TYPE_____	TYPE: []GEAR []V-BELT []CHAIN []VARIDRIVE	TYPE_____
HP_____	SIZE_____		SIZE_____
RPM_____	CAPACITY_____		CAPACITY_____
VOLTAGE_____	PRESSURE_____	SERVICE FACTOR_____	RANGE_____
AMPERAGE_____	ROTATION_____	RATIO_____	
PHASE_____	IMPELLER: SIZE_____		
FRAME_____	MATERIAL_____		

MAINTENANCE SUMMARY

EQUIPMENT NO. _____

DESCRIPTION _____

MAINTENANCE OPERATION	FREQUENCY
List briefly each maintenance operation required and refer to specific information in Manufacturer's Maintenance Manual, if applicable. Refer by symbol to "Lubricant List" for Lubrication Operation.	List required frequency of each maintenance operation.

LUBRICANT/RECOMMENDED SPARE PARTS LIST

EQUIPMENT NO. _____

DESCRIPTION _____

LUBRICANT LIST

LUBRICANT REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED AND MANUFACTURER
List symbol in "maintenance operation"	List general lubricant type	List specific lubricant name, viscosity and manufacturer
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

RECOMMENDED SPARE PARTS LIST

PART NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

NOTE: Identify parts provided by this Contract with two asterisks.

ADDITIONAL DATA AND REMARKS

_____

_____

_____

PROJECT NAME _____

CONTRACT NO. _____

CONTRACTOR _____

EQUIPMENT/SYSTEM _____

SECTION NO. _____

MANUFACTURER/VENDOR _____

FORMAT

Size:	8-1/2 x 11 or 11 x 17
Paper:	20-pound minimum
Text:	Printed data/neatly typed
Drawings:	Standard size bound in text; in text-size labeled envelopes

Tabbed Section Dividers

Cover Label:	Title Project Name Building/Structure ID Equipment Name Specification Section
Binders:	Plastic Cover

GENERAL CONTENTS

Provided	Not Applicable	Page No.	
_____	_____	____	One Specification Only
_____	_____	____	Title Page:
_____	_____	____	Title
_____	_____	____	Project title
_____	_____	____	Building/structure ID
_____	_____	____	Equipment name
_____	_____	____	Specification section number
_____	_____	____	Contractor ID
_____	_____	____	Subcontractor ID
_____	_____	____	Purchase order data
_____	_____	____	Manufacturer ID
_____	_____	____	Service/parts supplier ID
_____	_____	____	Product List
_____	_____	____	Table of Contents
_____	_____	____	Tabbed Sections:
_____	_____	____	Pertinent data sheets
_____	_____	____	Annotated as needed
_____	_____	____	Text:
_____	_____	____	Pertinent to project
_____	_____	____	Annotated
_____	_____	____	Drawings:
_____	_____	____	Illustrate product and components
_____	_____	____	Control and flow diagrams
_____	_____	____	Special Information:
_____	_____	____	Interrelationships of equipment and components
_____	_____	____	Instructions and procedures
_____	_____	____	Instructions organized in
_____	_____	____	Instructions in logical
_____	_____	____	Glossary
_____	_____	____	Warranty, Bond, Service Contract

MANUAL FOR MATERIALS AND FINISHES

Provided	Not Applicable	Page No.	
_____	_____	____	Building Products:
_____	_____	____	Product data
_____	_____	____	Catalog number
_____	_____	____	Size
_____	_____	____	Composition
_____	_____	____	Color and texture designations
_____	_____	____	Care and Maintenance Instructions
_____	_____	____	Recommended cleaning agents and methods
_____	_____	____	Cleaning precautions
_____	_____	____	Cleaning and maintenance schedule
_____	_____	____	Moisture Protection Products:
_____	_____	____	Product data listing
_____	_____	____	Chemical composition
_____	_____	____	Installation details
_____	_____	____	Inspection recommendations
_____	_____	____	Maintenance and repair
_____	_____	____	Additional Data as Required

MANUAL FOR EQUIPMENT AND SYSTEMS

Provided	Not Applicable	Page No.	
_____	_____	____	Description of Unit and Components:
_____	_____	____	Equipment functions
_____	_____	____	Normal operating characteristics
_____	_____	____	Limiting conditions
_____	_____	____	Performance curves
_____	_____	____	Engineering data
_____	_____	____	Test data
_____	_____	____	Replaceable parts list (with numbers)
_____	_____	____	P&ID numbers
_____	_____	____	Operating Procedures:
_____	_____	____	Startup
_____	_____	____	Break-in
_____	_____	____	Routine/normal operation
_____	_____	____	Regulation and control
_____	_____	____	Stopping and shutdown
_____	_____	____	Emergency
_____	_____	____	Seasonal operation
_____	_____	____	Special instructions
_____	_____	____	Maintenance Procedures:
_____	_____	____	Routine/normal instructions
_____	_____	____	Troubleshooting guide
_____	_____	____	Disassembly/reassembly/repair
_____	_____	____	Alignment/adjusting/balancing
_____	_____	____	Servicing and Lubrication:
_____	_____	____	List of lubricants
_____	_____	____	Lubrication schedule
_____	_____	____	Maintenance schedule
_____	_____	____	Safety Precautions/Features
_____	_____	____	Sequence of Operation of Controls
_____	_____	____	Assembly Drawings
_____	_____	____	Parts List and Illustrations:
_____	_____	____	Predicted life
_____	_____	____	Recommended spare parts list and prices
_____	_____	____	Control Diagrams/Schematics
_____	_____	____	Bill of Materials

Provided	Not Applicable	Page No.	
_____	_____	____	Completed Equipment Data Form per Specification
_____	_____	____	Valves
_____	_____	____	Catalog Cuts and Tag Numbers
_____	_____	____	Maintenance Instructions
_____	_____	____	Panelboard Directories:
_____	_____	____	Electrical
_____	_____	____	Controls
_____	_____	____	Communications
_____	_____	____	Instrumentation Loops:
_____	_____	____	Diagrams
_____	_____	____	Components list each circuit/loop
_____	_____	____	Additional Data As Required

SECTION 02221

BUILDING DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolishing designated structures.
2. Demolishing designated foundations.
3. Demolishing designated slabs-on-grade.
4. Disconnecting and capping designated utilities.
5. Filling designated underground tanks and structures.
6. Removing designated items for reuse and Owner's retention.
7. Protecting items designated to remain.
8. Removing demolished materials.
9. Abandonment of sewers.

1.2 SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for submittals.

1.3 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, subsurface obstructions, and limits of buried structure removal.

1.4 QUALITY ASSURANCE

A. Conform to applicable code for demolition of structures, safety of adjacent structures, dust control, and disposal of demolition wastes.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

1.5 SEQUENCING

A. Section 01100 - Summary of Work: Requirements for sequencing.

1.6 SCHEDULING

A. Section 01323 - Network Analysis Schedules: Requirements for scheduling.

B. Schedule Work to precede site excavation work and new construction.

C. Describe demolition removal procedures and schedule.

D. Prior to beginning work, submit demolition schedule and description of demolition removal procedures and sequence for review and approval by Owner.

E. Prior to commencing demolition work of any existing structures:
   1. Obtain written release from Owner for such structure.
   2. Reroute or shut off electrical, HVAC, process, and plumbing services outside the area of demolition.
   3. Salvage items specified for reuse in the Work or specified to be delivered to the Owner.
   4. Survey and record condition of existing facilities to remain in-place that may be affected by the demolition work. After work is completed, restore facilities to original condition at no additional cost to the Owner.

F. Protection:
   1. Structural stability of structures adjacent to or affected by demolition work shall be the Contractor's responsibility.
   2. Maintain in service and protect from damage existing facilities, utilities, and equipment to remain.

G. Utilities:
   1. Notify utilities prior to commencing demolition work to permit them to disconnect, remove, or relocate services at existing facilities.

H. Coordination:
   1. Perform demolition work in a manner which does not interfere with the Owner's operations.
   2. Coordinate demolition work so that new construction may proceed without undue delay.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Fill Material: Specified in Section 02320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Document condition of adjacent structures and buildings indicated to remain on site.

B. Make arrangements with building owners and occupants to survey interior and exterior of existing buildings.

3.2 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Do not close or obstruct roadways, sidewalks, or hydrants without permits.

D. Erect and maintain temporary barriers and security devices around perimeter of demolition site, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

E. Protect existing landscaping materials, trees, appurtenances, structures, and utilities indicated to remain.

F. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as required.

G. Drain or pump out basins to be demolished or abandoned. Dispose of liquid wastes properly.

3.3 DEMOLITION REQUIREMENTS

A. Use of explosives is not permitted without prior approval by Owner.

B. Conduct demolition to minimize interference with adjacent structures and plant operations.

C. Cease operations immediately when adjacent structures appear to be in danger. Notify Architect/Engineer. Do not resume operations until directed.

D. Conduct operations with minimum interference to public or private accesses. Maintain egress and access at all times.

E. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.

F. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.

3.4 DEMOLITION

A. Conduct demolition work as shown on the Drawings.

B. Disconnect, remove and cap designated utilities within demolition areas. Remove utilities and piping to limits shown on the Drawings. Plug or seal permanently with steel cap, concrete plug, or other approved method. Remove abandoned utilities and underground piping within influence zone of proposed piping and structures.

C. Remove foundation walls and footings to minimum of two feet below finished grade within area of new construction unless shown otherwise on the Drawings.

D. Remove concrete slabs-on-grade.

E. Empty underground tanks located within demolition area.

F. Remove demolished materials from site.

G. Fill underground tanks with fill material as specified in Section 02320. Disconnect and remove piping.

H. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect in accordance with requirements of Section 01600.

I. Backfill areas excavated, open pits, and holes resulting from demolition, in accordance with Section 02320.

J. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on the Drawings.

K. Continuously clean up and remove demolished materials from site. Do not allow materials to accumulate on site.

L. Do not burn or bury materials on site. Leave site in clean condition.

3.5 SALVAGE

A. Owner has first right to piping, valves and equipment being removed.

B. Salvage materials indicated on the Drawings.

C. Deliver piping, valves and equipment to location designated by Owner on site.

D. Remove and dispose of all piping, valves and equipment from site not required by Owner.

3.6 DISPOSAL

A. All waste materials from demolition work shall be removed from the site and disposed of in accordance with all applicable laws and regulations.

3.7 ABANDONMENT OF SEWERS

A. Sewers to be abandoned in place shall be filled with flowable fill sand or lean grout slurry and capped with concrete.

END OF SECTION

SECTION 02230

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, sidewalls and unsatisfactory base materials.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Basis of Measurement: Unless indicated otherwise, Site Clearing shall be paid incidental to and shall be included with the unit prices for the related work.

B. Basis of Payment: Includes clearing site, loading and removing waste materials from site, applying herbicide to designated plant life.

1.3 QUALITY ASSURANCE

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing work with utilities.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing plant life and features designated to remain are tagged or identified.

3.2 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.3 CLEARING

A. Clear areas required for access to site and execution of Work within construction limits.
   1. Construction limits shall be defined as road right-of-ways, easement boundaries, or limits defined in the Contract Documents.

B. Remove trees and shrubs within marked areas and as indicated. Remove trees, shrubs, stumps, surface rock, and roots.
   1. Grubbing shall be carried to a minimum depth of 12 inches.

C. Clear undergrowth and deadwood, without disturbing subsoil.

3.4 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Remove paving, curbs, sidewalks, and unsatisfactory base materials.
   1. Weak or soft spots in the base and/or subbase as a result of deposits of frost-heave, unstable silty soils, water bearing soil, topsoil or other undesirable foundation materials shall be removed and replaced with stone in accordance with Section 02320 of these Specifications.
   2. Payment for Base Repair Shall be per the unit price bid on the bid form.
   3. Pulverization shall comply with Section 325 of the Stabe Specifications. The depth of pulverization is the depth necessary to provide to provide suitable base course depth prior to the installation of the HMA pavement.
   4. Payment for pulverization shall be per the unit price bid on the bid form.

C. Sawcut pavement where removal limits terminate at existing pavement.

D. Pavement shall not be used for fill material on project site.

E. Contractor shall be responsible for obtaining an off-site disposal area.

F. Remove abandoned utilities within limits of construction or as shown. Indicated removal termination point for underground utilities on Record Documents.

G. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

H. Do not burn or bury materials on site. Leave site in clean condition.

END OF SECTION

SECTION 02311

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating topsoil.
2. Excavating subsoil.
3. Cutting, grading, filling, rough contouring, compacting site for site structures and streets.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 30 lb sample of structural fill to testing laboratory.
1. Submit two (2) copies of testing reports to the Owner's Representative.

1.3 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Excavated and reused material, graded, free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.
1. Screening: single screened.

B. Structural Fill: As specified in Section 02320.

C. Granular Fill: As specified in Section 02320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Identify required lines, levels, contours, and datum.

D. Notify utility company to remove and relocate utilities.

E. Protect utilities indicated to remain from damage.

F. Protect plant life, lawns, and other features remaining as portion of final landscaping.

G. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials for use in finish grading. In areas to be regraded with excess fill, strip topsoil prior to placement of excess fill and regrading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.

D. All excess topsoil shall remain on site. Uniformly spread excess topsoil on site in area's as directed by Owner or Engineer.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Undercut all slopes to provide for placing topsoil.

C. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

D. Stockpile excavated material in area designated on site and protect from erosion.

E. Benching Slopes. Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

G. Remove excess subsoil not intended for reuse, from site.

3.5 FILLING

A. Fill areas to contours and elevations with unfrozen materials.

B. Place fill material in continuous layers and compact in accordance with Section 02320.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Slope grade away from building minimum 1 percent, unless noted otherwise.

E. Make grade changes gradual. Blend slope into level areas.

F. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 FINISH GRADING:

A. Grade, trim, and shape to final grade and section.
   1. Adjust slopes by grading so that transition is smooth and gradual.
   2. The crests of cut banks shall be rounded and shaped.
   3. Washouts and ruts shall be refilled, regarded, and properly compacted.
   4. Remove all stones 3 inches or larger from grading limits.

3.7 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: Provide for the following testing and inspection services:
   1. Determine the maximum density and optimum moisture content for compaction in accordance with ASTM D698 (one test for each type of material for each source).\
   2. Conduct field density tests in accordance with ASTM D1556 and/or D2922 and ASTM D3017.
   3. Minimum frequency for field density testing shall be two (2) acceptable tests per project or as follows, whichever number is greater:
      a. Embankments, dikes, or berms: one test per 600 CY
      b. Structural fills: one test per 200 CY

C. Additional Testing
   1. Perform when:
      a. Densities do not meet project requirements.
      b. Method of compaction changes.

c. Cut areas are disturbed.

2. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

D. Test Rolling

1. Test roll finished cut or fill subgrades by rolling with a pneumatic-tire roller or a heave weight loader rubber tire vehicle.
   a. Method and equipment shall be suitable for intended use.
   b. Take necessary precautions to protect existing structures from damage during test rolling.
   c. Test roll and area equal to the area of the proposed construction plus a minimum of three (3) feet on each side.
2. Treat areas showing yielding or rutting under test rolling as follows:
   a. Replace and/or recompact as necessary to stabilize the area.
   b. Re-test soil areas replaced or recompacted at no cost to Owner.

END OF SECTION

SECTION 02315

EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating for building foundations.
2. Excavating for paving, roads, and parking areas.
3. Excavating for slabs-on-grade.
4. Excavating for site structures.
5. Excavating for landscaping.
6. Excavating for utilities.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location of utilities.

C. Identify required lines, levels, contours, and datum.

3.2 EXCAVATION

A. Underpin adjacent structures that may be damaged by excavation work, including utilities and pipe chases. All poles, buildings, fences, and other surface structures shall be protected and preserved by the Contractor and shall be repaired or replaced if necessary and left in as good condition as before Work started. All pipes conduits, sewers, drains, foundations, and other subsurface structures shall be properly supported and protected

during and after construction and repaired or replaced, if necessary, and left in as good condition as before Work started.

B. Excavate subsoil to accommodate building foundations, slabs-on-grade paving and site structures. At no additional cost to the Owner provide shoring, sheeting, bracing or other supporting structures to protect existing surface and subsurface structures, and to comply with regulatory requirements.
   1. Remove any unstable material from under proposed structures.
   2. Undercut material shall be removed a minimum of 5 feet beyond the structure and replaced with compacted structural fill sloped 1:1 at the perimeter.

C. Shoring and Bracing:
   1. Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Provide shoring, sheeting, and bracing required to excavate for and construct the pump station wet well structure.
   2. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at 24 inches below required grade elevation.

D. Compact subgrade to 95% Standard Proctor Density to a minimum depth of 6 inches in cut areas and proofroll.

E. Excavate to working elevation for piling work.

F. Compact disturbed load-bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and 02324.

G. Slope banks with machine to angle of repose or less until shored.

H. Do not interfere with 45 degree bearing splay of foundations.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Trim excavation. Remove loose matter.

K. Remove lumped subsoil, boulders, and rocks.

L. Notify Architect/Engineer of unexpected subsurface conditions.

M. Correct areas over excavated as specified in Section 02320. As directed by Architect/Engineer.

N. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.

O. Remove excess and unsuitable material from site.
   1. Haul and dispose of all excess and unsuitable materials.
   2. Provide disposal area for excess and unsuitable materials.

3. Pavement shall be disposed of separately from the soils material.
4. No material may be disposed of in a floodplain, wetland, or waterway.
5. In the event that the Owner provides a disposal site for surplus soils, the Contractor shall comply with the following incidental to the project:
   a. Strip topsoil from the site.
   b. Keep material leveled and provide drainage.
   c. Install and maintain erosion control.
   d. After site is filled, replace topsoil.
   e. Seed site for erosion control.

P. Removal of Water:
1. The contractor shall provide and operate a dewatering system to prevent water from entering any excavations.
2. Dewatering shall keep the groundwater level at least one foot below the bottom of the excavation. Dewatering shall be accomplished prior to excavation and shall be maintained until the finished work is safe from injury.
3. Water removed from the site shall be disposed of by the contractor such that it does not damage any adjacent property or work. The Contractor shall provide acceptable silt fencing, hay bales, and/or means to remove soil or fines from the water prior to disposal. Water removed from the site shall be disposed of by the Contractor such that it does not damage any adjacent property or work. Conform to the Erosion Control Plan in the Drawings.
4. All dewatering activities without wells shall conform to WDNR Code 1061. Contractor shall acquire all permits necessary for construction, operation, and removal of dewatering systems. If dewatering wells are required, the Contractor shall submit a High Capacity Dewatering Well Application (Form 3300-258) to the Wisconsin Department of Natural Resources. A high capacity system is defined as any well-based dewatering system sized at 70 gpm or greater. A copy of the WDNR approval form shall be forwarded to the Engineer prior to beginning construction. The WDNR's Private Water Supply Section's address for well permits is:

   Wisconsin Department of Natural Resources
   Private Water Supply Section
   Box 7921
   Madison, WI 53707

5. The costs of all sumps, wells, well points, piping, pumping, excavation, and other work associated with dewatering shall be borne by the Contractor.
6. Groundwater shall be conveyed to the point of discharge through pipelines; the use of open ditches or trenches is not permitted. Use of the Owner's utilities is not permitted without written consent.

Q. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and Inspection Services.

B. Provide for visual inspection of bearing surfaces before installing subsequent work.

3.4 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing. Provide protection against freezing when atmospheric temperature is less than 35˚ F until backfilling operations are completed.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 02320

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Site filling and backfilling.
7. Compaction.
8. Controlled low strength material fill for below grade abandoned structures.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Trench Fill Under Grass Area:
1. Basis of Measurement: Unless indicated otherwise, shall be paid incidental to and shall be included with the unit prices for the pipe installed
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

B. Fill Under Asphalt and Concrete Paving:
1. Basis of Measurement: By cubic yard foot.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

C. Trench Fill Material Under Asphalt and Concrete Paving:
1. Basis of Measurement: Unless indicated otherwise, shall be paid incidental to and shall be included with the unit prices for the pipe installed
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Fill to Correct Over-Excavation (Base Repair):
1. Basis of Measurement: By cubic yard.
2. Basis of Payment: Includes excavation and disposal of poor material, supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

E. Fill to Prevent Erosion:
1. Basis of Measurement: By cubic yard.
2. Includes supplying geotextile and fill material, stockpiling, scarifying substrate surface, and placing where required.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society for Testing and Materials:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
   5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
   7. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

C. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the “Standard Specifications.”

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for geotextile fabric indicating fabric and construction.

C. Samples: Submit, in air-tight containers, 30 lb sample of each type of fill to testing laboratory.

D. Materials Source: Submit name of imported fill materials suppliers.

E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 FILL MATERIAL

A. Crushed Stone: Imported stone processed by mechanical crushing of rock with substantially all faces fractured by the crushing; free of shale, clay, friable material, sand, debris; graded in accordance with ASTM C33 Size No. 67 within the following limits

Sieve Size	Percent Passing

1 inch	100
3/4 inch	90 to 100
3/8 inch	20 to 55
No. 4	0 to 10
No. 8	0 to 5

B. Bedding/Cover Material:

1. Crushed Stone Chips: Crushed stone chips shall be made from crushing sound limestone, dolomite ledge rock, or other rock materials of regional significance. The material shall be hard, tough and durable. The crushing process shall produce material of which 85% to 100% of the particle shall have at least one machine fractured face, crushed pea gravel will be acceptable if it meets this criteria:

   Gradation Requirements for Crushed Stone Chips:

Sieve Size	Percent Passing
1/2 inch	100%
3/8 inch	90 to 100
No. 8	0 to 15
No. 30	0 to 3

2. Bedding Sand: Bedding sand shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. The presence of approximately 6% of fine clay or loam particles is desirable, but clay or loam lumps are not permitted. The maximum moisture content shall be 10%

   Gradation Requirements for Bedding Sand:

Sieve Size	Percent Passing
1 inch	100%
No. 16	45 to 80
Finer Than No. 200	2 to 10

C. Sand or Gravel: Well graded sand or gravel; free of clay and silt lumps, loam, friable of soluble materials, or organic matter meeting the following:

1. Gravel:

Sieve Size	Percent Passing

1 inch	95 to 100
3/4 inch	70 to 90
3/8 inch	50 to 85
No. 4	35 to 65
No. 10	25 to 50
No. 40	10 to 30
No. 200	0 to 5

2. Sand:

Sieve Size	Percent Passing
3/8 inch	75 to 95
No. 4	60 to 80
No. 30	15 to 35
No. 200	0 to 5

D. Granular Backfill: (To be installed within right of way if beneath or within 3 feet of back of curb line). Fine to coarse-graded sand; free of clay and silt lumps, loam, friable or soluble materials, or organic matter; graded in accordance with ASTM C136, within the following limits:

Sieve Size	Percent Passing
1 inch	100
No. 16	45 to 80
No. 200	2 to 10

E. Structural Fill (Engineered Fill): Compacted fill shall be processed soil or rock materials free of deleterious, friable, soluble, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated", and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) of 30 and a Plasticity Index (ASTM D-424) of 15. The top 12-inches of the compacted fill shall have a maximum particle size of 3-inch diameter and all underlying compacted fill shall have a maximum particle size of 6-inch diameter. All fill materials must be tested and approved by the Engineer prior to placement (or delivery to the site if imported).

F. Rip Rap: Stone pieces ranging in weight from approximately 25 to 150 pounds, with not less than 50 percent of pieces weighing more than 60 pounds.

G. Heavy Rip Rap: Field Stones, well-graded, ranging in weight up to approximately 400 pounds. Not less than 50 percent of the total volume shall consist of stones weighing at least 150 pounds, and not less than 80 percent of the total volume shall consist of stones weighing at least 40 pounds.

H. Common Fill: Soil, free of non-earth materials, less than 7% organic content defined by Loss-on-Ignition. Test ASTM D-2974, and maximum particle size of 8-inches.

I. Base Course: As specified in Section 02721.

J. Drainage Stone: Graded in accordance with ASTM C33 coarse aggregate, Size No. 57 within the following limits:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	Maximum 10

K. Breaker Run Stone: Large-sized aggregate resulting from the mechanical crushing of rock, boulders, large stone or salvaged concrete, the results of which are not screened or processed beyond the initial crushing size. Breaker run stone shall be graded within the following limits:

Sieve Size	Percent Passing
5 inch	100
1½ inch	0 to 50

L. Granular Trench Fill: Granular backfill in conformance with Section 8.43.4 of the Standard Specifications.

M. Aggregate Slurry Backfill: Aggregate slurry backfill in conformance with Section 8.43.8 of the Standard Specifications.

N. Fill materials shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other materials.

2.2 GEOTEXTILE FILTER FABRIC

A. Non-woven, manufactured with the following minimum average roll values from samples in accordance with ASTM D4354. (The following values may be obtained from the manufacturer.)

Property	ASTM Test

	Value	Method
Grab Strength	180 lbs.	D4632
Seam Strength(a)	160 lbs.	D4632
Puncture Strength	80 lbs.	D3787
Burst Strength	290 lbs./in2	D3786
Trapezoidal Tear	50 lbs.	D4533
AOS	Greater than No. 30 sieve (less than 0.6mm)	D4751

[(a)]Alternatively, overlap geotextile a minimum of 18 inches.

B. Protect geotextile during storage from becoming wet, coming in contact with soil, cement, or other foreign materials, and from exposure to sunlight.

C. Geotextile Fabric, Type HR: Shall comply with Section 645 of WISDOT Standard Specifications for use with heavy rip-rap.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth recommended by engineer.

D. Proofroll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

E. Prior to placement of aggregate base course material at paved areas, mechanically compact subsoil to 95 percent of its maximum dry density in accordance with ASTM D698.

3.3 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place geotextile fabric where required prior to placing next lift of fill.

D. Place and compact fill material in continuous layers not exceeding 8 inches compacted depth and compact in accordance with schedule at end of this section.

E. Employ placement method that does not disturb or damage other work.

F. Maintain optimum moisture content of backfill materials to attain required compaction density.

G. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

H. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

I. Backfill only against concrete that has been properly cured, coated, tested and accepted.

J. Fill excavations below bottom of foundation or footing elevations within influence zone with concrete or structural fill.

K. Begin compaction of each layer at structure wall.

L. Utilize compactors of 550 lbs or less in weight within 5 feet of structure wall.

M. Slope grade away from building minimum 1 percent unless noted otherwise.

N. Make gradual grade changes. Blend slope into level areas.

3.4 TOLERANCES

A. Top Surface of Backfilling Within Building Areas: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 4 inches from required elevations.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: In accordance with ASTM D698, ASTM D2922, ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

D. Proof roll compacted fill surfaces under paving.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SCHEDULE

A. Mat Foundation and Interior Slab-On-Grade:
   1. Existing soils or structural fill to 6 inches below subgrade soils or structural fill to 6 inches below subgrade elevation compacted to 95 percent and sand or gravel fill to subgrade compacted to 95 percent.

B. Exterior Side of Foundation Walls and Retaining Walls:
   1. Granular Backfill, within 4 – 6 feet from walls, to 1–2 feet below subgrade elevation, each lift compacted to 90 percent; compacted clayey soils to subgrade.

C. Fill Under Grass Areas:
   1. Common fill, to 6 inches below finish grade, compacted to 85 percent.

D. Fill Under Asphalt and Concrete Paving:
   1. Structural fill, to 12 inches below base course subgrade finish paving elevation, compacted to 95 percent, and structural fill to subgrade elevation compacted to 100 percent.

E. Trench Fill Material Under Asphalt and Concrete Paving:
   1. Granular trench fill, to subgrade elevation compacted to 95 percent.

F. Fill to Correct Over-excavation:
   1. Structural fill, flush to required elevation, compacted to 95 percent.

G. Fill to Prevent Erosion:
   1. 24-inch minimum heavy rip rap placed over non-woven geotextile Type HR

H. Interior of lift station wet well and valve vault, and manholes being demolished:
   1. Aggregate slurry backfill, flush to top of the remaining structure.

3.8 SECURITY

A. Provide security and facilities to protect Work, and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

END OF SECTION

SECTION 02324

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities, culverts, storm and sanitary sewers, drains, and piping to limits shown on the Drawings.
2. Compacted bedding.
3. Backfilling and compaction.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Unless indicated otherwise, Trenching shall be paid incidental to and shall be included with the unit prices for the pipe installed.

B. Basis of Payment: Includes excavating to required elevations, protecting excavation, stockpiling excavated materials, removing excess excavated materials from site, pipe bedding, and required backfill.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society for Testing and Materials:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Product Data: Submit data for geotextile fabric indicating fabric and construction.

D. Samples: Submit, in air-tight containers, 30 lb sample of each type of fill to testing laboratory.

E. Materials Source: Submit name of imported fill materials suppliers.

F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Trench backfill above pipe zone shall be Structural Fill or Common Fill materials as specified and scheduled in Section 02320.

2.2 BED MATERIALS

A. Bedding Material:
   1. For pipes larger than 18-inches in diameter, as specified for Crushed Stone in Section 02320.
   2. For pipes 18-inches in diameter or less, as specified for Bedding/Cover Material in Section 02320.

2.3 TRENCH STABILIZATION:

A. Crushed Stone: As specified for Crushed Stone in Section 02320.

2.4 PIPE ZONE MATERIALS:

A. Pipe zone materials shall be cover material as follows:
   1. For trenches with Class “B” bedding, cover material shall be as specified for Crushed Stone in Section 02320 for pipes larger than 18-inches in diameter; cover material shall be as specified for Bedding/Cover Material in Section 02320 for pipes 18-inches in diameter or less. Cover Material shall be same as bedding material.
   2. For trenches with Class “C” bedding, cover material shall be as specified for Structural Fill in Section 02320.

2.5 CONCRETE ENCASEMENT

A. Provide concrete encasement where shown on the Drawings or required by the specifications. Concrete shall conform to the requirements of Section 03300.

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.
   1. Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Verify that fill materials to be reused are acceptable prior to use.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for installation of utilities.

B. Remove lumped subsoil, boulders, and rock.

C. Cut trenches sufficiently wide to enable installation as shown on the Drawings and allow inspection. Remove water or materials that interfere with Work. Provide dewatering in accordance with Section 02315.

D. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

E. Do not interfere with 45 degree bearing splay of foundations. Provide shoring to protect existing foundations when excavating adjacent buildings and structures.

F. When Project conditions permit, slope side walls of excavation. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.

G. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth until suitable material is encountered.

H. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Structural Fill and compact to density equal to or greater than requirements for subsequent backfill material.

I. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

J. Correct over excavated areas with compacted backfill as specified for authorized excavation.

K. Remove excess subsoil not intended for reuse, from site.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BEDDING

A. Support pipe and conduit during placement and compaction of bedding fill.

B. Class B bedding shall be provided as shown on Drawings in the following locations:
   1. Under all structures, footings, and slabs.
   2. Under all asphalt and concrete paving.

3. Adjacent to existing structures, when pipe centerline is within 5 feet of the structure.
4. When crossing under existing piping, utilities, and duct banks.

C. Class C bedding shall be provided as shown on Drawings in the following locations:
1. Under grass and landscaped areas.

D. Provide concrete encasement where shown on the Drawings or required by the Specifications.

3.6 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place geotextile fabric where required.

D. Place fill material in continuous layers not exceeding 8 inches compacted depth.

E. Employ placement method that does not disturb or damage foundation perimeter drainage, or utilities in trench.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Protect open trench to prevent danger to Owner and the public.

3.7 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 3 inches from required elevations.

3.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Compaction Testing: In accordance with ASTM D698, ASTM D2922, ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest. At no cost to Owner.

3.9 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 02448

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes
1. Specifications for installation of pipelines by horizontal directional drilling. Water transmission main shall be installed by horizontal directional drilling unless noted otherwise.
2. Work shall include piping connections to existing piping, or to pipes installed by other methods.
3. The Work shall include all testing as required under Divisions 1 and 2.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Unless indicated otherwise, Horizontal Directional Drilling (HDD) shall be paid incidental to and shall be included with the unit prices for the pipe installed.

B. The unit price for HDD pipe shall include the following.
1. Excavation, use, and backfilling of all access and exit pits.
2. Pilot tunnel boring.
3. Removal and disposal of spoils and drilling fluid including all costs associated with use of vacuum excavation equipment.
4. Traffic control including efforts to maintain access to roads and driveways during all HDD operations.
5. All costs and activities associated with “potholing” to expose existing utility lines.
6. Any and all labor, equipment, and materials required to complete the work not previously called out above.

1.3 SUBMITTALS

A. Pipe Logs
1. The requirements for the necessary pipe location logs are found in detail under Field Quality Control. Submit a written report to Engineer documenting location and depth of pipe.
2. Submit logs and summary of stresses on pipe during installation.

B. Equipment Data
1. Furnish data on tracking systems that will be used. Data shall include depth and accuracy capabilities of equipment.

C. Drilling Fluids
1. Submit manufacturer's data. Data shall include material specifications, handling procedures, method of mixing, and special precautions.

D. Pipe Design
   1. Submit design calculations.

1.4 REFERENCES

A. Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, Part VI.

B. Handbook of Polyethylene Pipe, 2nd Edition, Plastics Pipe Institute, 2007.

PART 2 PRODUCTS

2.1 DRILLING FLUID

A. Drilling fluid shall be bentonite clay mixture. Contractor may use a polymer additive at Contractor's option. Fluid and additives shall not be hazardous to the environment.

2.2 PIPE

A. Pipe shall be HDPE specified in Section 02619. All water transmission main shall be installed by horizontal directional drilling.

2.3 PIPE ANALYSIS

A. Contractor shall verify the pipe DR required based on the proposed installation procedures, and the following analysis:
   1. Tensile Pull Load: (Based on pipe weight, pipe friction on the ground, pipe friction in the borehole, flotation loads, and submersion load; tensile load shall be calculated for a minimum of three conditions: when the pipe enters the borehole, midway through insertion, and as the pipe leaves the ream hole.) Limit tensile stress to 1,600 psi.
   2. Bending stress on pipe sidewalls during installation.
   3. Net longitudinal compressive stress, based on bending stresses.
   4. Total longitudinal axial stress from sustained loads.
   5. External differential pressure collapse/buckling resistance.
   6. Earth load on pipe following installation at maximum depth.

B. Summarize results in a tabular format including values used for pipe physical properties.

C. Include sketches to show critical installation dimensions.

D. The SDR used shall be the lower of that specified by Engineer in Section 02619 or that required by the above analysis.

PART 3 EXECUTION

3.1 SITE CONDITIONS

A. Contractor shall examine the site(s) indicated. The limits of surface excavation shall be located at drilling pits, boring pits, valve vaults, fittings and interconnections as shown on the Drawings. Contractor shall be responsible for locating the borehole and receiving hole sufficiently back from the limits of excavation to allow connection to the horizontally drilled pipe. Pits shall be of length and width as determined by Contractor and approved by the Engineer to be necessary to install pipes and sized to fit area available for work.

3.2 PROTECTION

A. Provide all required sediment and erosion control measures to prevent drilling fluid or borehole cuttings from entering adjacent storm drainage ditches or piping.

3.3 INSTALLATION

A. Directional Drilling Equipment

1. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe using the drilling pit locations shown on the Contract Documents, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the installation, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

B. Drilling Rig

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurize fluid mixture to guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations. The rig shall be grounded during drilling and pullback operations.

C. Drill Head

1. The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets. The drill head shall be controlled by a precision guidance system.

D. Precision Guidance System.

1. The Contractor shall utilize a precision guidance system for control of directional boring system. The system must be designed for grade control, DitchWitch 86 BG and Subsite 750 Tracker or approved equal.

2. The guidance system shall provide pitch information with a resolution of 0.1 percent or better at the design grade and monitor the depth to drill bit along the bore path within 5% at a depth of 20 feet. The bore tracking instrumentation shall provide an as-built map of the bore, superimposing the actual bore path on the projected design path. The design grade shall be set and checked by the Contractor at least every 10 feet along the path of the bore

E. Pilot Hole

1. Pilot hole shall establish the horizontal plane of the pipeline. A plot of length versus elevation versus left/right variance will dictate the actual as-built plan and profile of the pipeline. Data feedback and electronic guidance systems and supplemental surface tracking systems shall be used to provide confirmation of position.
2. The bore shall be maintained within 5% of design grade based upon depth of bore (e.g. 0.5 ft at 10 ft depth). The Contractor shall make any and all checks necessary to confirm the bore is preceding within the specified accuracy limits.
3. Minimum depths are indicated on the Drawings. Pipes shall be installed at greater depths if necessary to permit movement of trapped air to air release high points. Avoid underground obstructions by steering horizontally around them. Pipe may be installed at greater depths to facilitate the installation if the proposed greater depth is reviewed and approved by Engineer before installation.

F. Reaming

1. Reaming shall consist of using an appropriate tool to open the pilot hole to a slightly larger diameter than the carrier pipeline. The percentage over size shall depend on soil types, soil stabilities, depth, drilling fluid hydrostatic pressure, etc. Normal oversizing shall be from 120 to 150 percent of the carrier pipe diameter. Drilling fluid shall be forced down the hole to stabilize the hole and to remove soil cuttings.

G. Pull Back

1. Pull back the entire pipeline length in one segment back through the drilling fluid along the reamed hole pathway. Proper pipe handling, cradling, bending minimization, surface force readings, constant insertion velocity, drilling fluid flow circulation/exit rate, and footage length installed shall be recorded. The pull-back speed shall be within the pipe manufacturer's recommendations.
2. Any bits, drills, reamers, or other tools lost or stuck in the hole shall be removed at Contractor's expense. If tools cannot be readily removed, Contractor may at Contractor's option abandon the hole. No payment shall be made for any lost equipment, material, or work on abandoned holes.

H. As-Built Drawings

1. As-built drawings shall be submitted by the Contractor based upon the pipe log data. As-built drawings shall be certified as to accuracy by the Contractor.

I. Allowable Tolerances in Pipe Depth

1. A variation greater than 6-inches from the horizontal plan or designated grade is sufficient reason for rejection of the pipe, and pipe shall be re-bored to proper grade if so directed by Engineer at no cost to Owner.

J. Drilling Fluid

1. Drilling fluid to be used to facilitate installation of the pipe shall be adjusted within acceptable limits such that ground heaving and subsurface cavity formation through erosion are prevented.

K. Locating and Protecting Existing Utilities

1. Contractor shall take appropriate precautions to prevent damage to existing utilities where they cross either above or below the proposed Horizontal Directionally Drilled pipe. Exposing the existing utility prior to installing the directionally drilled pipe may be necessary to verify appropriate separation is being maintained and that no damage will occur to the existing utility. The cost for locating existing utilities and for making these exploratory excavations shall be incidental to the work.

L. Relief Holes

1. The contractor shall drill/excavate relief holes to prevent the pressure of the drilling fluid from heaving or in any other way damaging any surface features. The number and frequency of the relief holes shall be as necessary to prevent borehole blows (“frac outs”). Damage due to ground heaving or frac outs caused by the drilling fluid shall be repaired at the Contractor's expense. Relief holes shall be incidental to the work.

M. Number of Set-Ups

1. The alignment shown on the drawings is intended to be adhered to unless prevented by physical obstructions. The required machine capacity to achieve the length of pipe installation per setup and the alignment shown on the plans is the Contractor's responsibility. Any and all costs associated with increasing the number of setups is the Contractor’s responsibility. No additional compensation will be provided for the number of setups required to install the pipe according to the plans. All setups shall be restored at the Contractor's expense unless the Contractor is required to install a pit or other excavation as requested by the Engineer.

3.4 CLEAN-UP AND RESTORATION

A. Spent drilling fluid and cuttings shall be confined to vicinity of drilling rig. Any drilling fluid which enters the pipe shall be removed by flushing or other suitable means.

B. Contractor shall be responsible for cleanup and restoration of any damage due to borehole blow. No additional payment shall be made for cleanup costs required by Owner, Engineer, or regulatory agencies due to a loss of drilling fluid.

C. Restoration

1. Pits excavated for construction and connection of bored pipe shall be backfilled, and disturbed surface shall be restored as described under other Division 2 specifications.
2. Provide surface restoration to match existing surfaces prior to disturbance.

3.5 FIELD QUALITY CONTROL

A. Pipe Logs

1. Logs shall be kept giving the horizontal and vertical position of the force main with maximum 25-foot intervals along the pipe to confirm its conformance to specified depth and line shown on the Drawings. Complete tracking information in computer readable format, as well as the as-drilled map, shall be supplied following the bore for record purposes.
2. No payment for any length of pipe shall be made without a log accompanying it.

END OF SECTION

SECTION 02483

SEGMENTAL CONCRETE RETAINING WALL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Foundation.
2. Precast concrete modular units.
3. Foundation drain.
4. Free draining backfill.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Basis of Measurement: By square foot.

B. Basis of Payment: Includes services and components required for complete wall system, including but not limited to design and installation of precast concrete modular retaining wall system, excavation, reinforced concrete footing, modular units, geotextile, foundation drain, and backfill.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
2. AASHTO T22 - Standard Specification for Compressive Strength of Cylindrical Concrete Specimens.
3. AASHTO T23 - Standard Specification for Making and Curing Concrete Test Specimens in the Field.
4. AASHTO T119 - Standard Specification for Slump of Hydraulic Cement Concrete.
5. AASHTO T141 - Standard Specification for Sampling Freshly Mixed Concrete.
6. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
7. AASHTO T231 - Standard Specification for Capping Cylindrical Concrete Specimens.
8. AASHTO T235 - Standard Specification for Bearing Capacity of Soil for Static Load on Spread Footings.

B. ASTM International:
1. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
8. ASTM C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
9. ASTM C1194 - Standard Test Method for Compressive Strength of Architectural Cast Stone.
10. ASTM C1195 - Standard Test Method for Absorption of Architectural Cast Stone.
11. ASTM C1262 - Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
12. ASTM C1364 - Standard Specification for Architectural Cast Stone.
13. ASTM C1372 - Standard Specification for Segmental Retaining Wall Units.
14. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
15. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
16. ASTM D1194 - Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings.
17. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
18. ASTM D1729 - Standard Practice for Visual Appraisal of Colors and Color.
19. ASTM D2244 - Standard test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates.
20. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
21. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
22. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
23. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
24. ASTM D4751 - Standard Test Method for Determining the Apparent Opening Size of a Geotextile.

C. National Concrete Masonry Association:
1. NCMA TEK 2-4A - Specification for Segmental Retaining Wall Units.
2. NCMA TR 127A - Design Manual for Segmental Retaining Walls.
3. NCMA TR 146 - Segmental Retaining Wall Installation Guide.

D. National Institute of Building Sciences:
1. NIBS - U. S. National CAD Standard.

E. Precast/Prestressed Concrete Institute:
1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
3. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

1.4 SYSTEM DESCRIPTION

A. Retaining Wall System: Battered wall of stepped height formed from precast concrete modular facing and tieback units in configuration shown on drawings with foundation drain, backfill, and coping.

1.5 DESIGN REQUIREMENTS

A. General
1. Do not change indicated horizontal and vertical alignment of retaining walls, except as specified in this section.
2. Design retaining walls to be within the following specified design parameters.

B. Design footing wall facing and tieback units in accordance with specified NCMA requirements and the following:
1. External Stability Factor of Safety:
a. Base Sliding: 1.5.
b. Overturning: 2.0.
c. Bearing Capacity: 2.0.
d. Global Stability: 1.3.
2. Internal Stability Factor of Safety:
a. Shear Capacity: 1.5.
3. Retained Aggregate Backfill:
a. Unit Weight: 130 lb/cu ft.
b. Friction Angle: 30 degrees.
c. Cohesion: 0 lb/sq ft.
4. Foundation Backfill:
a. Unit Weight: 130 lb/cu ft.
b. Friction Angle: 30 degrees.
c. Cohesion: 0 lb/sq ft.
5. Design Geometry:
a. Provide length, height, and overall elevations of retaining wall as indicated on Drawings.
b. Measure structure's design height, H, from top of footing to top of wall where ground surface intercepts wall facing.
c. See Drawings for slopes above and below sections of segmental retaining wall.
6. Minimum Wall Embedment: Greater of height of a modular unit, 0.5 feet or following minimum embedment required for slope below wall:
a. Level: H/10.
b. 3: 1 (18.4 degrees): H/10.
c. 2: 1 (26.5 degrees): H/7.
7. Surcharges: Apply following surcharges to top of each design cross section based on the following uses above wall.
a. No Traffic: 0 lb/sq. ft.
b. Light Traffic: 100 lb/sq. ft.

c. Heavy Traffic: 250 lb/sq. ft.

8. Lateral Earth Pressure: Calculate lateral earth pressure to be resisted by self weight of retaining wall using Coulomb coefficient of earth pressure, Ka, times vertical stress at base of wall. Use coefficient of active earth pressure, Ka, from top to bottom of wall. Assume coefficient of active earth pressure, Ka, independent of external loads except sloping fills. For sloping fills, use coefficient of active earth pressure, Ka, appropriate for sloping condition, using Coulomb earth pressure in analysis.

9. Inclination of Failure Surface: Assume Coulomb failure surface passing through base of wall behind facing units up to ground surface at or above top of wall in design of wall.

10. Dead Loads for Wall:
    a. Unit Weight of Concrete: 150 pcf.
    b. Unit Weight of Backfill Material: 120 pcf.
    c. Equivalent Fluid Earth Pressure: 40 pcf.

11. Live Loads for Wall:
    a. Vehicle Impact Loading: 10 kip/5 feet.

12. Foundation Data for Wall:
    a. Allowable Bearing Pressure: 4.0 ksf.

1.6 PERFORMANCE REQUIREMENTS

A. Design walls for locations and to overall dimensions indicated on Drawings utilizing specified backfill and foundation parameters.

B. Use no experimental or demonstration-type design concepts; or products, structures, or elements not preapproved by Architect/Engineer, in design.

1.7 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Manufactured Modular Wall - Modular Units and Support: Indicate type of wall, location, length, top elevation, bottom of footer elevation, cross-sections including backfill material type and limits, and quantities. Show complete layout plans and fabrication details for precast wall units, and step-by-step erection instructions. Indicate, unit locations, architectural details, unit identification marks, support items, dimensions, openings, and relationship to adjacent materials, signed and sealed by professional engineer licensed in the State of Wisconsin.

2. Temporary Support System: Detail specific load bearing falsework, underpinning, needling, or shoring layout and support members appropriate for Project conditions.

C. Product Data: Submit data for cast modular units, soil reinforcement, and other accessories.

D. Samples:

1. Submit representative samples of each cast modular unit, illustrating profiles, finish, texture and color.

E. Design Data: Submit the following signed and sealed by professional engineer.
1. Calculations for manufactured modular wall including height of precast units, overall wall stability including sliding stability and overturning stability, and forces acting on wall and footing, precast facing and tieback units in accordance with design requirements.
2. Submit details and computations for any required temporary shoring, bracing and temporary support of excavation.

F. Submit documentation of experience in list of at least five projects of similar construction and scope which substantiate experience for system. Include brief description of each project and name and phone number of owner's representative knowledgeable in each listed project.

G. Test Reports: Indicate certified tests results for precast concrete at manufacturing facility, cast-in-place concrete in field, and granular backfill.

H. Manufacturer's Installation Instructions: Submit installation instructions including construction sequence and scheme and following:
1. Excavation and required bracing.
2. Placement of footing.
3. Placement of precast concrete facing units and tieback units.
4. Placement of drainage, backfill and geotextile.

I. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

J. Manufacturer's Field Reports: Indicate field observations and conclusions as to compliance to specifications, action items, and resolution of installation issues.

1.8 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual elevation of undercut base, if any, and foundation elevation and position.

1.9 QUALITY ASSURANCE

A. Perform precast work in accordance with requirements of PCI MNL-116S, PCI MNL-123, PCI MNL-120.

B. Perform required manufactured modular retaining walls work in accordance with NCMA, TR 127A, NCMA, TR 146.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing manufactured modular retaining wall systems with minimum five years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years documented experience approved by manufacturer.

C. Design and construct manufactured modular retaining wall including temporary support under direct supervision of professional engineer experienced in design of this Work and licensed in State of Wisconsin.

1.11 MOCKUP

A. Section 01400 - Quality Requirements: Requirements for mockup.

B. Construct mockup 20 feet 5 feet with facing and tieback units specified including backfill, wall drain, architectural details and finish, and specified wall coatings. Fabricate sample wall unit by same process for production units.

C. Locate where directed by Architect/Engineer.

D. Incorporate accepted mockup as part of Work.

1.12 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum two weeks prior to commencing work of this section.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Check materials upon delivery to assure receipt of proper material. Inspect for damage. Replace damaged materials.

C. Handle, store and ship units to avoid chipping, cracking, and fracturing and to prevent contamination that may affect performance.

D. Protect materials from damage during storage and installation. Remove and replace damaged units.

1.14 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install foundation when subgrade is wet or frozen.

1.15 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.16 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with wall penetrations, connection to storm water system, affected utility companies, and utility adjustments.

PART 2 PRODUCTS

2.1 FOUNDATION MATERIALS

A. Coarse Aggregate: As specified in Section 02320, Crushed Stone.

B. Concrete: As specified in Section 03300.

2.2 WALL SYSTEM MATERIALS

A. Manufacturers:
1. Anchor Wall Systems Model.
2. Keystone Retaining Wall Systems, Inc.
3. Rockwood Retaining Walls
4. Unilock Wall Systems
5. Or equal.

B. Modular Face and Tieback Units:
1. Product Description: ASTM C1372 precast solid concrete units, zero slump molded under high vibration and pressure, with as cast finish:
   a. Standard units: Closed face containing off-set tongue and groove for self-battering, chamfered unit facing to create random block appearance and form exterior facia.
   b. Coping units: Same as standard units without tongue
   c. Tie-back Units: Manufacturer's standard reinforced unit as required for specified design conditions in accordance with shop drawings.
2. Concrete Materials: Refer to Section 03300.
3. Steel Reinforcing: Refer to Section 03200.

2.3 BACKFILL AND DRAINAGE SYSTEM

A. Aggregate:
1. Coarse Aggregate Backfill: Crushed Stone as specified in Section 02320.

B. Filter Fabric: As specified in Section 02320.

C. Foundation Drain Pipe
1. Furnish materials in accordance with Section 02620.

2.4 CONCRETE MIX:

A. Compressive Strength: ASTM C39/C39M ASTM C140; minimum 4000 psi at 28 days.

B. Freeze Thaw and Maximum Moisture Absorption Rate: ASTM C1262, 8 percent to ensure adequate freeze thaw protection.

C. Slump: ASTM C143/C143M zero slump.

2.5 FABRICATION

A. Retaining Wall Modules: Solid units, manufacturer's standard rock face.

2.6 PLANT FINISHING - PRECAST CONCRETE

A. Finish surfaces of precast concrete units uniform in color and appearance.

B. Cure units under identical conditions to develop required concrete quality, and minimize appearance blemishes including non-uniformity, staining, or surface cracking.

C. Finish units to PCI MNL-116S Standard sculptured rock face in an angular multi-planar configuration.

2.7 FABRICATION TOLERANCES

A. Maximum Variation from Indicated Dimensions: 1/8 inch for overall dimensions for width, height, and length.

2.8 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.

B. Maintain plant records and quality control program during production of cast units. Make records available upon request.

C. Testing and Inspection. Sample and test precast units including slump, unit weight, temperature, entrained air in concrete mixture, and compression.

D. Sample and test concrete units with respect to compressive strength on basis of production lot results. Define production lot as units a single compressive test result represents from one day's production.

E. Visually inspect to detect defects, cracks, and chipping due to imperfect proportioning, mixing or molding; surface defects and excessive voids; and areas beyond repair. Architect/Engineer may reject units for color variations on front face due to excess form oil, cracks, chips or other visual appearance defects.

F. Sample and test materials for manufacturing of precast units including cement, aggregates, water, admixture, and steel reinforcement according to this Section. Make results of quality control tests available for Architect/Engineer's review, upon request.

G. Resistance to Freezing and Thawing: In accordance with ASTM C666; maximum cumulative percent mass loss 5% after 300 cycles.

H. Visually inspect color differences between fabricated units and approved sample in accordance with ASTM D1729.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify site conditions and foundation soil bearing capacity after excavation.

C. Verify with Architect/Engineer base of undercut, if any, to complete necessary removal of unsuitable material and replacement of material with coarse aggregate.

3.2 DEWATERING

A. As specified under Section 02315.

3.3 EXCAVATION AND FOOTER

A. Provide temporary support of excavation when required in accordance with Section 02315 and shop drawings.

B. Excavate to indicated lines and elevations in accordance with Section 02315.

C. Grade foundation for structure level for width required by manufacturer's instructions.

D. Remove and replace foundation soil including unsuitable soils to minimum depth of 6 inches with compacted crush stone.

E. Place bottom of footing as shown on the Drawings.

3.4 DRAINAGE AND BACKFILL

A. Place perforated structure foundation drainage pipe behind footing as indicated on Drawings and in accordance with Section 02620. Lay pipe at minimum gradient of 2 percent to ensure drainage to free outlets.

B. Place and compact crushed stone backfill material in maximum 12 inch.

C. Place and compact soil backfill material above crushed stone backfill from top of wall to finished ground in maximum 6 inch (200 mm) lifts.

D. Maintain optimum or less moisture content of backfill materials to attain required compaction density.

E. Seed, mulch, and fertilize finished ground from top of wall to existing grade in accordance with Section 02924.

3.5 INSTALLATION OF MODULAR UNITS

A. Assemble units as shown on shop drawings and in accordance with manufacturer's recommendations.

B. Connect tie-back units to standard facing units by interlocking tongue and groove and support in rear with standard units. Align tie backs vertically in spacing required by manufacturer.

C. Place first course of precast concrete modular retaining wall units on compacted crushed stone footing. Ensure that wall modules are aligned properly, leveled from side to side and front to back and are in complete contact with footer.

D. Place wall modules above bottom course such that tongue and grove arrangement provides design batter of wall face. Place successive courses to create running bond pattern with edge of units being approximately aligned with middle of unit in course below it.

E. Place units side by side for full length of wall alignment. Ensure correct retaining wall lines, curves, jogs, and steps for first course.

F. Sweep excess material and remove burrs from top of units before placing additional levels to ensure that no dirt, concrete or other foreign materials become lodged between successive lifts of wall modules. Install next course maintaining required vertical alignment as shown on shop drawings. Stagger full bearing of concrete units over vertical joints below. Do not use blocks, wedges, or other devices for permanent shimming of wall units.

G. Check level of wall modules with each lift to ensure that no gaps are formed between successive lifts.

H. Repeat erection sequence until grades indicated on Drawings are achieved.

I. Secure coping units to top of wall with two 3/8 inch beads of flexible concrete adhesive positioned 2 inches in front and behind tongue of last course of retaining wall units.

J. Handle and erect concrete units carefully so as to avoid damage to units. Replace any members damaged to extent where their aesthetics or structural integrity is compromised.

3.6 ERECTION TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. The following tolerances are maximum allowable deviation from indicated construction:
   1. Vertical Control: plus or minus 1.25 inches over a 10 ft distance, plus or minus 3 inches (76 mm) total.
   2. Horizontal Control: plus or minus 1.25 inches over a 10 ft distance, plus or minus 3 inches total.
   3. Rotation: plus or minus 2 degrees from planned wall batter.
   4. Bulging: 1.0 inch over a 10 ft distance.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements 01700 - Execution Requirements: Field inspecting, and testing.

B. Field test concrete in accordance with Section 03300.

C. Compaction Testing: As specified in Section 02320.

3.8 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish manufacturer’s representative at Project site to assist Contractor, and Architect/Engineer until they are familiar with and confident in installation, and construction procedures.

C. Furnish monthly visits to Project site by company representative during wall construction.

END OF SECTION

SECTION 02611
PVC BELL AND SPIGOT SEWER PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC sewer pipe with bell and spigot joints.

1.2 UNIT PRICE - BASIS OF MEASUREMENT

A. Basis of Measurement: By the linear foot.

B. Basis of Payment: Includes excavating, bedding, pipe and fittings, and specified backfill.

1.3 REFERENCE SPECIFICATIONS

A. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the "Standard Specifications."

B. ASTM F477: Elastomeric Seals (Gaskets) for joining Plastic Pipe.

C. ASTM F679: PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings

D. ASTM F794: PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

E. ASTM D1784: Specification for Rigid PVC Compounds and CPVC Compounds.

F. ASTM D3034: Type PSM PVC Sewer Pipe and Fittings.

G. ASTM D3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.4 SUBMITTALS

A. As specified in Section 01330.

B. Certification that the pipe materials comply with the requirements of this Specification Section.

1.5 MEASUREMENT AND PAYMENT

A. The cost of work in this Section shall be paid at the unit price per lineal foot stated in the bid form.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Gravity Sewer Material: Polyvinyl Chloride (PVC) sewer pipe, SDR 35, meeting the requirements of ASTM Specification D3034 for sewer pipe less than or equal to 15-inch diameter and meeting the requirements of Section 8.10 of the Standard Specifications.

B. Sewer Lateral Material: Polyvinyl Chloride (PVC) sewer pipe, meeting the requirements of ASTM Specification F679 with T-1 wall thickness for sewer pipe 18-inch through 21-inch diameter and meeting the requirements of Section 8.10 of the Standard Specifications.

C. Performance:
   1. Impact resistance: No shattering or splitting shall be evident (denting is not considered a failure) when tested in accordance with ASTM D2444.
   2. Pipe Stiffness:
      a. Performance: Minimum 46 psi "Pipe Stiffness" (F/ y) at 5% deflection for all pipe sizes.
      b. Test method: Testing in accordance with ASTM D2412, "External Loading Properties of Plastic Pipe by Parallel-Plate Loading."
   3. Joint tightness: Tested in accordance with ASTM D3212.
   4. Flattening:
      a. Performance: No evidence of splitting, cracking, or breaking when tested.
      b. Test method: Flatten specimen of pipe, six inches long between parallel plates in a suitable press until the distance between the plates is forty percent of outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed two to five minutes.
   5. Testing temperature: 73º F ± 3º F.

D. Joints: Push-on type bell and spigot configuration compatible with that of the pipe and in accordance with ASTM D3212 requirements, with elastomeric ring gasket complying with ASTM F477.

E. Fittings: Fittings such as elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe, meeting the requirements of ASTM D3212, ASTM F477, ASTM D3034.

2.2 LUBRICANT

A. Provide manufacturer's standard for pipe and gasket materials.

PART 3 WORKMANSHIP

3.1 HANDLING PIPE

A. Handle pipe in accordance with manufacturer's instructions. Do not handle pipe with chains or cables. Do not drop pipe.

3.2 CUTTING PIPE

A. Saw cut pipe in accordance with manufacturer's instructions. All cuts to be square, perpendicular to pipe axis, within tolerance of joints.

3.3 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections that may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by leveling, as recommended by the pipe manufacturer.

3.4 JOINTING PIPE

A. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstances.

3.5 TESTING

A. Leakage Testing: The “low pressure air test” method of leakage testing shall be required in accordance with Section 3.7.3 of the Standard Specifications. Testing shall be conducted by the Contractor under the observation of the Inspector.

B. Deflection Testing: Deflection testing of PVC sewer pipe shall be required in accordance with Section 3.2.6(i)4 of the Standard Specifications. Testing shall be conducted by the Contractor under the observation of the Inspector. The Contractor shall submit all test results to the Village.

C. All sanitary sewer lines shall be televised after all tests have been completed and a hard copy record report with VHS tape or compact disc of televising results shall be provided to the Village of Grafton Water and Wastewater Utility.

END OF SECTION

SECTION 02612

PVC PRESSURE PIPE – ANSI/AWWA C900

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC pressure pipe, 4 inch through 12 inch, with bell and spigot joints for force main.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The cost for work in this Section shall be paid at the unit price per lineal foot stated in the Bid Form.

B. The cost of ductile iron fittings are incidental to bid item for force main.

C. The cost of joint restraint to be incidental to the respective bid items for force main.

1.3 REFERENCE SPECIFICATION

A. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the “Standard Specifications”.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Certification that pipe material complies with requirements of ANSI/AWWA C900.

PART 2 PRODUCTS

2.1 PIPE

A. Material: Polyvinyl Chloride (PVC) pressure pipe meeting the requirements of ANSI/AWWA Standard,C-900, DR-18, with cast iron O.D. and integral elastomeric bell and spigot joints.

B. Markings: Pipe shall bear external markings displaying nominal pipe size, pipe material, SDR number, AWWA designation.

2.2 JOINTS

A. Joints shall be bell and spigot. Spigot pipe ends shall be factory supplied with bevels conforming to ASTM D3139. The bell shall consist of an integral wall section with a solid cross section elastomeric ring, and shall be as hydrostatically strong as the pipe wall.

1. Elastomeric rings shall be factory installed butyl or hypalon rubber gaskets conforming to ASTM F477, "Elastomeric Seals (gaskets) for Joining Plastic Pipe".

B. Joint restraint shall be provided by use of Megalug restrained joints Series 2000PV for C-900 PVC pipe.

C. Joint restraint shall be provided in the following locations:
1. At all elbows (except 90° elbows) and all joints within 20 feet of all elbows.
2. At all 90° elbows and all joints within 40 feet of all 90° elbows.

2.3 FITTINGS

A. Ductile iron, 350 psi minimum working pressure, cement-lined and seal-coated. Where taps are shown on fittings, tapping bosses shall be provided.
1. Push-On or mechanical: ANSI A21.10, AWWA C110 and ANSI A21.11, AWWA C111, American Ductile Iron Pipe, U.S. Pipe and Foundry, or equal, or compact fittings ANSI A21.53, AWWA C153, U.S. Pipe and Foundry, Clow Corporation, or equal. All fittings shall be wrapped with polyethylene encasement in accordance with ANSI/AWWA C105.
2. Fittings to be included as part of pipe cost.

2.4 BOLTS & NUTS

A. Mechanical Joint:
1. Size, length, and number as shown in AWWA C110 and AWWA C115.
2. Material: Carbon Steel, 60,000 psi tensile strength, ASTM A307, Grade B.
3. Dimensions: ANSI B18.2.1, heavy hex.

2.5 LUBRICANT

A. Provide manufacturer's standard for pipe and gasket materials. Do not substitute any other material for manufacturer’s joint lubricant.

2.6 TRACER WIRE

A. The tracing wire shall be Neptco Trace-Safe® Sewer blocking tracer wire RT 1803W (Green) with 19 gauge conductor and 1800 pound strength minimum.

B. Tracer wire stations shall be Rhino TriView TracerPed™ Green/Sewer, with internal terminals.

PART 3 WORKMANSHIP

3.1 INSTALLATION

A. Handling Pipe:
1. Handle pipe in accordance with manufacturer's instructions. Do not handle pipe with chains or cables. Do not drop pipe.

B. Cutting Pipe:

1. Saw cut pipe in accordance with manufacturer's instructions. All cuts to be square, perpendicular to pipe axis, within tolerance of joints.

C. Dressing Cut Ends:

1. Dress cut ends of pipe in accordance with the type of joint to be made.
2. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.
3. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.

D. Jointing Pipe:

1. Join pipe in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer and no substitutes will be permitted under any circumstances.
2. Care should be exercised to keep dirt, stones, mud, and other debris out of the pipe while assembling pipe sections. Contractor shall immediately remove such materials from inside the piping prior to proceeding with a pipeline assembly.

E. Tracer Wire:

1. Install with all buried non-metallic pipe, with ends terminating at grade in tracer wire stations.
2. Provide tracer wire stations at ends of lines, at all drilling pit locations, and at distances less than 1,000 feet between tracer wire stations, and at all hydrants (located behind the hydrants) on water lines. Provide sufficient length for test station installation height of 4 feet above finished grade.
3. Perform continuity testing at each test station to demonstrate wire continuity after completion of pipe installation. Demonstration testing must be performed in the presence of the Engineer. Submit test report to document test results.
4. If continuity testing fails, Contractor shall find and repair tracer wire discontinuities in accordance with the manufacturer’s instructions.

3.2 LEAKAGE TESTING

A. Testing of force main pipe shall be hydrostatic tests in accordance with Chapter 4.15.0 of the Standard Specifications. Contractor shall take care to insure that all fittings, valves, hydrants and bolts are secured to withstand pressures in excess of the test pressure.

B. Test pressure shall be 100 psi gauge. Contractor shall provide water for testing and shall leave water in piping following testing. All air shall be expelled from the pipe prior to testing. Testing shall be performed after all backfilling and compaction has been completed. Contractor shall test piping at intervals not to exceed 1,000 feet and shall test the entire length when complete. Contractor may, at his/her discretion, test piping at more frequent intervals. However, final approval will only be given when the entire pipeline passes testing. No installation will be accepted if leakage exceeds the value determined by the following formula:

$$L = ND _ P$$

7400

in which	L	=	leakage in gallons per hour
	N	=	number of joints under test
	D	=	nominal diameter of main in inches
	P	=	average test pressure

C. The costs for pipe testing shall be considered incidental to the work and included in the appropriate unit prices stated in the Bid Form.

END OF SECTION

SECTION 02619

HIGH DENSITY POLYETHYLENE (HDPE)
SOLID WALL PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for High Density Polyethylene (HDPE) pipe or fusible polyvinylchloride pipe to be installed by horizontal directional drilling.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The cost for work in this Section shall be paid at the unit price per lineal foot stated in the Bid Form.

B. The cost of ductile iron fittings are incidental to bid item for force main.

C. The cost of joint restraint to be incidental to the respective bid items for force main.

1.3 REFERENCES

A. ASTM International:
1. ASTM D618 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
2. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
3. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
4. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

B. American National Standards Institute/American Water Works Association:
1. ANSI/AWWA C906-07 – Polyethylene (PE) Pressure Pipe and Fittings, 4 inch though 63 inch., for Water Distribution and Transmission

C. American Water Works Association:
1. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution.
2. AWWA C605 - Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

D. NSF International:
1. NSF-14 - Plastics Piping System Components and Related Materials
2. NSF-61 - Drinking Water System Components--Health Effects

E. Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition (Standard Specifications).

F. Handbook of Polyethylene Pipe, 2nd Edition, Plastics Pipe Institute, 2007.

1.4 SUBMITTALS

A. Submittals shall conform to requirements of Division 1.

B. Submit shop drawings showing design of pipe, fittings, electrofusion couplings, buried pipe anchors, etc. indicating laying dimensions and fabrication.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 1. Exercise care in transporting and handling pipe and fittings in order to avoid damage to materials or coatings. Lifting shall be by hoist or on skids when hand lifting is not feasible. Dropping shall not be permitted. Store pipe as recommended by the manufacturer. Damaged pipe and fittings shall be replaced.

1.6 QUALITY CONTROL

A. As a basis for acceptance of the product, the manufacturer shall furnish a certificate of conformance to the specifications.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS:

A. Design was based on using 14-inch high density polyethylene (HDPE) pipe for both the force main and sanitary sewer. 12-inch fusible polyvinylchloride pressure (PVC) pipe can be used in place of the HDPE piping as shown and called out. Contractor is responsible for any changes related to use of fusible PVC pipe.

B. High Density Polyethylene (HDPE) Pipe:

1. Pipe and fittings shall have a working pressure rating of 160 psi, DR 11 minimum wall thickness and the Sanitary Sewer having a DR 9 minimum wall thickness. The pipe shall be extruded from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin shall meet the specifications of ASTM D3350 with a cell classification of PE345464C; and ASTM D-1248 pipe grade resin Type III, Class C, Category 5, Grade PE34 polyethylene compound. Materials shall conform to AWWA C906, NSF Standard #14 and 61. Fittings shall be molded from a polyethylene compound having a cell classification equal to or exceeding the cell classification of the pipe supplied under this specification.
2. Pipe is to be of solid wall construction and shall have DIPS (Ductile Iron Pipe Size) outside dimensions.
3. DR rating and cell classification shall be stamped on pipe as prescribed by AWWA C906 and NSF.

4. The pipe shall contain no recycle compound except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, or other injurious defects, and shall be nominally identical in color density, melt index and other physical properties throughout.

C. Fusible Polyvinylchloride Pressure Pipe:

1. Fusible polyvinylchloride pipe shall have a working pressure rating of 235 psi, DR 18 minimum wall thickness. Pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
2. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
3. Fusible polyvinylchloride pipe shall be manufactured in a standard 40’ or 45’ nominal length, or custom lengths as specified.
4. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.2 INSPECTIONS

A. The Engineer shall be entitled to inspect pipes or witness pipe manufacturing. Such inspection shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards within this specification.

2.3 MARKING AND DELIVERY

A. Each standard and random length of pipe in compliance with this standard shall be clearly marked with the following information:

1. Pipe Size
2. Pipe Class
3. Production Code
4. Material Designation

2.4 TRACER WIRE

A. The tracing wire shall be Neptco Trace-Safe® Sewer blocking tracer wire RT 1803W (Green) with 19 gauge conductor and 1800 pound strength minimum.

B. Tracer wire stations shall be Rhino TriView TracerPed™ Green/Sewer, with internal terminals.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pipe Cleaning During and Following Installing Operation

1. Should the pipe ends become dirty or dusty during the storage of the pipe, a thorough cleaning of the pipe shall be done just before the joint of pipe is fused and installed. At the termination of pipe installation, the open end of the pipeline shall be closed off by a suitable cover until installation operations are resumed.
2. Provide interim cleaning following installation to remove dirt, debris and other foreign matter.

B. Joining HDPE Pipe
1. Butt Fusion: Sections of HDPE pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt heat fusion method (per ASTM D2657) and shall be performed in strict accordance with the pipe manufacturer's recommendations. Joining shall utilize controlled temperature and pressure to produce a fused leak-free joint. The butt heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including but not limited to, temperature requirements, alignment, and interfacial fusion pressure. Only personnel certified by pipe manufacturer as fusing technicians shall perform this work.
2. Electrofusion: HDPE pipe may also be joined as necessary at or near valves and fittings by using approved electrofusion couplings and electrofusion processor (per ASTM D2657). Electrofusion processor shall be "Friatec", "Central", or approved equal. Only personnel certified by pipe manufacturer shall perform this work.

C. Joining Fusible Polyvinylchloride Pipe
1. Unless otherwise specified, fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier’s written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

D. Buried Pipe Anchors for HDPE Pipe
1. The Contractor shall install buried pipe anchors for the HDPE piping system when the force main connects to existing piping, non-restrained joint piping, or where the force main terminates at a dead end. Buried pipe anchors shall be as per the manufacturer and shall consist of an appropriate HDPE restraint anchor securely attached to the force main, which shall be adequately encased in concrete at a point in close proximity to the mechanical joint.

E. Restrained Mechanical Joints for HDPE Pipe
1. A mechanical connector with restraint capabilities will be required at all mechanical joints. Restrained joints shall use full circumference clamping and will only be considered subject to pre-approval by Engineer. All fittings shall be specifically designed and pre-approved for use with HDPE pipe, and installed in strict conformance with the manufacturer's instructions (Mueller AquaGrip System or approved equal). Megalugs and similar fittings using set screws or drive lugs into the wall of the pipe will not be allowed.
2. Mechanical connectors with restraint capabilities shall be installed at interconnections with existing PVC/DIP force mains, mechanical joint bends deflecting 11-1/4 degrees or more, and at all mechanical joint fittings in accordance with the manufacturer's recommendations. Additionally, restraints

shall be installed on all mechanical pipe line joints within 25 feet of any bend or fitting in both directions.

3. Transition from HDPE pipe to either PVC or DIP pipe shall be accomplished by use of a HDPE pipe manufacturer approved mechanical joint adaptor system with restraint capabilities.
4. Provide Type 304 stainless steel nuts, bolts and washers (as applicable) on all fittings. The threads of all stainless steel fasteners shall be coated with marine grade anti-seize and lubricating compound, either shop applied or field applied.

F. Restrained Mechanical Joints for Fusible PVC® Pipe

1. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.
2. Ductile Iron Mechanical Fittings per the requirements of Section 02612.

G. Tracer Wire

1. Install with all buried non-metallic pipe, with ends terminating at grade in tracer wire stations.
2. Provide tracer wire stations at ends of lines, at all drilling pit locations, and at distances less than 1,000 feet between tracer wire stations, and at all hydrants (located behind the hydrants) on water lines. Provide sufficient length for test station installation height of 4 feet above finished grade.
3. Perform continuity testing at each test station to demonstrate wire continuity after completion of pipe installation. Demonstration testing must be performed in the presence of the Engineer. Submit test report to document test results.
4. If continuity testing fails, Contractor shall find and repair tracer wire discontinuities in accordance with the manufacturer's instructions.

3.2 TESTING

A. All installed piping shall be hydrostatically tested at 150 psi gauge pressure in accordance with the Standard Specifications.

END OF SECTION

SECTION 02630

STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Storm drainage piping.
2. Accessories.
3. Catch basins and plant area drains.
4. Cleanouts.
5. Bedding and cover materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:
1. Basis of Measurement: By the linear foot.
2. Basis of Payment: Includes excavating, bedding, pipe and fittings, granular cover.

B. Catch Basin and Cleanout:
1. Basis of Measurement: By each unit.
2. Basis of Payment: Includes excavating, bedding, foundation pad, unit installation with accessories, connecting to sewer piping.

1.3 REFERENCES

A. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the “Standard Specifications.”

B. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society for Testing and Materials:
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C14M - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).
4. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
5. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).
6. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

7. ASTM C443M - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
8. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
9. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
10. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
11. ASTM C969M - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).
12. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
13. ASTM C1103M - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).
14. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
15. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
16. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
17. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
18. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
19. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
20. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
21. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
22. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
23. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
24. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
25. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
26. ASTM C-507 – Standard Specification for Reinfored Concrete Elliptical Culvert, Storm Sewer, and Sewer Pipe.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data indicating pipe, pipe accessories, and castings.

C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Project Record Documents:
1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State and Local Codes Governing Work.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with termination of storm sewer connection outside building, trenching, connection to foundation drainage system.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe:
1. Diameters 12-inch to 24-inch: ASTM C76 Class as shown on the Drawings, bell and spigot ends.
1. Diameters larger than 24-inch: ASTM C76 Class III with Wall Type B; inside nominal diameter as shown on the Drawings, bell and spigot ends.
2. Fittings: Reinforced concrete.
3. Joints: ASTM C443 rubber compression gasket.
4. Flared End Sections: ASTM C76

B. PVC sewer pipe for diameters less that 12-inch:
1. ASTM D3034, SDR 35, inside nominal diameter as shown on the Drawings, bell and spigot ends.
2. Joints: ASTM D3212 elastomeric.

C. Catch basin leads:
1. Size: 12" diameter.
2. Leads with less than 3-feet of cover to finished grade: Reinforced Concrete Pipe: ASTM C76 Class V.

D. All pipe and end sections:
1. Reinforced Concrete Pipe or Pipe Arch conforming to the Standard Specifications.
2. All end sections on circular pipes require pipe grates. The cost of grates shall be incidental to the cost of the end section.

E. Reinforced Concrete Elliptical Pipe:
   1. ASTM C-507 as shown on drawings, bell and spigot ends.
   2. Joints: rubber gasket in accordance with ASTM C-443.
   3. Flared end sections ASTM C-507.

2.2 CATCH BASINS AND PLANT AREA DRAINS

A. Frames and grates for storm sewer structures:
   1. Curb inlet frames: Neenah R-3067 with 2" radius curb box, and Type "L" slotted grate.
   2. Field inlet frames: Neenah R-1710 with a Type “B” catch basin lid.
   3. Manhole frames: As specified in Section 02633.

B. Shaft Construction and Cone Top Section: Reinforced precast Concrete pipe sections, conforming to section 02633.

C. Base Pad: As specified in Section 02633.

D. Catch Basins shall be 48” diameter pre-cast concrete per file No. 25 of the Standard Specifications, with a minimum 24-inch sump depth.

E. Storm Manholes shall be 48” diameter pre-cast concrete structures conforming to the Standard Specification.

F. Field Inlets shall be at least 42” diameter pre-cast concrete structure conforming to the Standard Specification, with a minimum 24-inch sump depth.

G. Top slabs (decks) for storm structures shall be capable of supporting a standard wheel load. "Flat-top" type manholes may be used, if approved by the Engineer.

H. All manholes shall have adjustments from 2-inch minimum to 14-inch maximum, with either concrete or HDPE rings (Ladtech or equal).

2.3 BEDDING AND COVER MATERIALS

A. Bedding: Minimum 6 inches Crushed Stone, as specified in Section 02320.

B. Cover: Minimum 12 inches of Crushed Stone, as specified in Section 02320.

C. Fill Materials: Trench backfill above pipe zone shall be structural fill or common fill materials as specified and scheduled in Section 02320.

2.4 ACCESSORIES

A. Filter Fabric: Non-biodegradable, as specified in section 02320.

B. Grout: Specified in Section 03300.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation as specified in Section 02320.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Section 02324 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal joints watertight.

B. Place pipe on minimum 6 inch deep bedding material.

C. Lay pipe to slope gradients noted on drawings with maximum variation from indicated slope of 1/8 inch in 10 feet.

D. Refer to Section 02320 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.

E. Refer to Section 02633 for manhole requirements.

F. Connect to subdrainage tile system piping. Refer to Section 02620 if applicable.

G. Install site storm drainage system piping to within 5 feet of building. Connect to building storm drainage system. Refer to Section 15160 if applicable.

3.5 INSTALLATION - CATCH BASINS AND INLETS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place Cast-In-Place Concrete base pad, with provision for storm sewer pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

C. Deflection Test
1. Perform deflection tests on all PVC gravity sewer pipe.
2. Pipe deflection shall not exceed 5%.
3. Conduct tests a minimum of 30 days after backfill has been placed.
4. Pull test mandrel without mechanical means.
5. Provide mandrels in accordance with the following:
a. PVC SDR 35 (ASTM D3034)

Pipe Size (inches)	Mandrel Size (inches)
8	7.28
10	9.08
12	10.79
15	13.20

b. PVC (ASTM F679)

Pipe Size (inches)	Wall Thickness	Mandrel Size (inches)
18	T-1A	16.13
18	T-2B	16.20
21	T-1A	19.00
21	T-2B	19.09
24	T-1A	21.36
24	T-2B	21.46
27	T-1A	24.06
27	T-2B	24.17

3.7 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
   1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
   2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 02633

MANHOLES, FRAMES, AND COVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Monolithic concrete manholes with masonry transition to cover frame, covers, anchorage, and accessories.
2. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to cover frame, covers, anchorage, and accessories.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Manhole:
1. Basis of Measurement: By vertical foot invert to rim stated in the Bid Form.
2. Basis of Payment: Includes excavating, concrete base pad, concrete manhole sections, cover frame and cover, grade rings, chimney seal, forming and sealing pipe inlets and outlets.

1.3 REFERENCES

A. The Standard Specifications for Sewer and Water Construction in Wisconsin, latest edition, hereinafter referred to as the “Standard Specifications.”

B. American Concrete Institute:
1. ACI 318 - Building Code Requirements for Structural Concrete.
2. American Society for Testing and Materials:
3. ASTM A48 - Standard Specification for Gray Iron Castings.
4. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A536 - Standard Specification for Ductile Iron Castings.
6. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
7. ASTM C55 - Standard Specification for Concrete Brick.
8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
9. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
10. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
11. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.4 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C913.

C. Design of Joints for Precast Structures: In accordance with ASTM C913.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate manhole locations, elevations, piping and conduit, sizes and elevations of penetrations.

C. Product Data: Submit manhole covers, component construction, features, configuration, and dimensions.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with applicable State and Local Codes governing Work.

1.7 DELIVERY, STORAGE AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and drainage structures.

C. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES, FRAMES, AND COVERS

A. Manufacturers:
   1. Neenah Foundry Co. Model numbers as shown.
   2. Substitutions: Section 01600 Product Requirements.

B. Manhole Sections: Reinforced precast concrete conforming to Chapter 8.39.0 of the Standard Specifications in accordance with ASTM C478 with gaskets in accordance with

ASTM C923. Minimum wall thickness shall be 4 ½ inches; minimum inside diameter shall be 48 inches.

1. Manhole section joints shall be tongue and groove with compression type rubber gaskets conforming to ASTM C443 and Standard Specifications Chapter 8.39.5.

C. Mortar and Grout: As specified in Chapter 8.37.0 of the Standard Specifications.

D. Reinforcement: Steel reinforcement shall conform to Chapter 8.44.0 of the Standard Specifications.

E. Cover and Frame:

1. Product Description: ASTM A48 Class 35B Cast iron construction, machined flat bearing surface, as shown on the Drawings. Frames and covers not detailed on drawings shall be Neenah R-1710-B non-rocking, solid gasketed "self-seal" cover, concealed pick hole with gasketed "B" pattern lids; or equal. Lids shall be lettered "SEWER".
2. Anchored manhole frame and cover as detailed on drawings: Neenah R-1710-B as specified above with type "E" locking, including a minimum of 3 hex head cap screws and 1-inch anchor holes.

2.2 COMPONENTS

A. Manhole Steps: Steel reinforced plastic, conforming to Chapter 8.40 of the Standard Specifications.

B. Base Pad: Cast-in-place concrete conforming to Chapter 8.35 of the Standard Specifications, Type A, leveled top surface. Provide concrete formwork.

C. Manhole Extensions: Concrete or HDPE (Ladtech or equal) grade rings for extensions shall conform to Chapter 8.39.11 of the Standard Specifications.

D. Pipe Connectors: All connections between pipes and manholes shall be made through watertight resilient connectors as shown on the Drawings.

E. Chimney Seals: Provide internal chimney seals "Cretex" internal chimney seal, or approved equal, from the casting to the precast cone section.

2.3 CONFIGURATION

A. Manhole configurations shall be as shown on the Drawings.

B. Design Depth: Provide depth to accommodate to elevations indicated on Drawings.

C. Clear Cover Opening: 26 inches or as indicated on Drawings.

D. Pipe and Conduit Entry: Furnish openings as indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify items provided by other sections of Work are properly sized and located.

C. Verify built-in items are in proper location, and ready for roughing into Work.

D. Verify correct size of manhole excavation.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate for manholes and drainage structures in accordance with Section 02315 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes or drainage structures in dry trench.
   3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Install manholes and drainage structures supported at proper grade and alignment on compacted crushed stone bedding as shown on Drawings.

C. Place base pad, trowel top surface level.

D. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

E. Backfill excavations for manholes and drainage structures in accordance with Section 02320.

F. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As Work progresses, build fabricated metal items and accessories as shown on the Drawings.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel as indicated on Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

I. Coordinate with other sections of Work to provide correct size, shape, and location.

3.4 PRECAST CONCRETE MANHOLE AND DRAINAGE STRUCTURE INSTALLATION

A. Lift precast structures at lifting points designated by manufacturer.

B. When lowering manholes and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 02320 or on other support system shown on Drawings.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer's plant.

G. Verify manholes and drainage structures installed satisfy required alignment and grade.

H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.

I. Cut pipe to finish flush with interior of structure.

J. Shape inverts through manhole as shown on Drawings. The manhole invert shall provide a smooth transition between channels. No sharp edges or rough sections which will tend to obstruct the flow will be permitted. Where a full section of sewer pipe is laid through the manhole, the top shall be cut out as shown or approved, and the exposed edge of the pipe shall be completely covered with mortar. All cement mortar used in the construction of the invert shall be troweled smooth.

3.5 CASTINGS INSTALLATION

A. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

B. Manhole Extensions: The extensions shall be built in accordance with the details shown on the Drawings. The actual height of extensions shall be as determined by the Engineer. All manholes shall have a minimum of one 2-inch adjusting ring and a maximum of 14-inches of adjusting rings.

3.6 FIELD QUALITY CONTROL

A. Water infiltration testing: The “water infiltration test” method of leakage infiltration shall be required in accordance with Section 3.7.2 of the Standard Specifications. Testing shall be conducted by the Contractor under the observation of the Inspector.

B. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 02721

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Crushed aggregate base course.
2. Leveling Course.
3. Shoulder.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.3 REFERENCES

A. State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, 1996 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

B. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
2. American Society for Testing and Materials:
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
6. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 30 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Delivery Tickets: Provide delivery tickets daily for each load of crushed aggregate for base course delivered to the work, including:
   1. Date
   2. Tare and net weight
   3. Type of material

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregates from recycled material may not be used unless required as part of this project.

B. Crushed Aggregate Base Course: Section 304 of the Standard Specifications, Crushed Stone Graduation No. 2:
   1. The aggregates shall consist of hard, durable particles of crushed stone or crushed gravel and a filler of natural sand, stone sand or other finely divided mineral matter. Oversize material encountered in deposits from which the material is taken shall be removed by screening or shall be crushed to the required sizes. The composite material shall be substantially free from vegetable matter, shale and lumps or balls of clay, and shall conform to the pertinent gradation requirements.
   2. Unless otherwise specified in the contract, the aggregate shall have a percentage of wear of not more than 50, as determined by AASHTO Designation: T 96.
   3. The aggregate, including any blended filler, shall have a liquid limit of not more than 25 and a plasticity index of not more than six except in the case of aggregates for base courses placed between old and new pavements, where the plasticity index shall not exceed three.
   4. At least 45 percent, by count, of the number of particles of aggregate retained on the No. 4 sieve shall have at least one fractured face.
   5. When the fraction of aggregate retained on the No. 4 sieve is subjected to five cycles of the sodium sulfate soundness test, weighted loss shall not exceed 18% by weight.
   6. Additional mineral filler required to meet gradation requirements or for satisfactory binding of material shall be uniformly blended with base course material at the screening plant. Mineral fillers shall be free from agglomerations or lumps and shall contain not more than 15% of material retained on a No. 4 sieve.
   7. Moisture content shall not exceed 7%

Graduation Requirements

	Percentage Passing By Mass			
	Gradation No. 2		Gradation No. 3	
Sieve Size	Crushed Gravel	Crushed Stone	Crushed Gravel	Crushed Stone
37.5 mm	--	--	--	--
25.0 mm	100	100	100	100
19.0 mm	--	--	95-100	95-100
9.5 mm	50-85	40-75	50-90	50-90
4.75 mm	35-65	25-60	35-70	35-70
2.00 mm	25-50	15-45	20-55	15-55
425 µm	10-30	--	10-35	--
75 µm	3-10*	3-12	8-15	5-15

C. Leveling course: Section 304 of standard specifications, crushed stone, Gradation No. 3, per the Table above.

D. Shoulder: Section 304 of standard specifications, crushed stone, Gradation No. 3 (traffic bond), the rest may be Gradation No. 2 or 3.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Prior to the placement of aggregate for the streets, contractor shall furnish and install Type-1 geo-grid. Geo-grid shall be Geo Star 6B1515 or equal. Spread aggregate over prepared substrate to a total compacted thickness as shown on the Drawings.

B. The work shall proceed so that the hauling equipment will travel over the previously placed material. No hauling shall be permitted on the subgrade. Route hauling equipment as uniformly as possible over all portions of the previously constructed layers of base course.

C. Compact placed aggregate materials to achieve at least 95 percent of its maximum dry density in accordance with ASTM D698.

D. Areas where proper compaction cannot be obtained due to segregation of materials, excess fines or other deficiencies shall be reworked or the material be removed and replaced with material that will yield the desired results.

E. Maintain line and grade during compaction operations.

F. Level and contour surfaces to elevations and gradients indicated.

G. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

H. Maintain optimum moisture content of fill materials to attain required compaction density.

I. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

J. Spread leveling coarse over crushed aggregate base coarse to a total compacted thickness as shown on the Drawings. Place and compact in the same manner as per the crushed aggregate base coarse.

K. Shoulder material shall be placed and compacted to a total thickness as shown on the Drawings, and in accordance with Sec. 304.5 of standard specifications.

L. Contractor shall be responsible for and maintain the base course until surface paving is complete.

M. Contractor shall maintain dust control until paving is completed by the application of water or an approved dust control material.

3.4 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.

C. Maximum Variation From Thickness: 1/4 inch.

D. Maximum Variation From Elevation: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: Contractor shall arrange for testing services as follows:
1. Source testing
   a. Sampling: AASHTO T2
   b. Sieve Analysis
      1) AASHTO T27 for aggregates including fracture count
      2) AASHTO T37 for mineral fillers
   c. Liquid test: AASHTO T89
   d. Plasticity index: AASHTO T90
   e. Soundness: AASHTO T104 using sodium sulfate
   f. Standard Proctor: ASTM D698
2. Installation testing
   a. Perform a minimum of one (1) moisture/density test per 10,000 sq. ft. per layer of base course placed.
      1) Comply with ASTM D2922 (Nuclear Method).
   b. Perform a minimum of one (1) sieve analysis per day conforming with:
      1) AASHTO T27 for aggregates including fracture count.
      2) AASHTO T37 mineral fillers.
   c. Additional density and gradation testing
3. Perform additional density and gradation testing under following circumstances:
   a. Aggregate density does not meet project requirements
   b. Change in method of compaction
   c. Change in source or quality of aggregate

C. When the testing results show that the work is of an acceptable nature, the acceptance of the work shall not relieve the Contractor from making corrections to the tested work during the warranty period.

END OF SECTION

SECTION 02740

FLEXIBLE PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphaltic concrete binder and surface courses.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

B. Asphalt Pavement Mix (Base Course):
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes preparing base, primer, tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

C. Asphalt Pavement Mix (Binder Course):
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

D. Asphalt Pavement Mix (Wearing Course):
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes tack coating surfaces, placing, compacting and rolling, testing. Includes mix design, supplying to site, testing.

E. Tack Coat:
1. Basis of Measurement: By gallon.
2. Basis of Payment: Includes preparing surfaces and applying.

1.3 REFERENCES

A. State of Wisconsin, Department of Transportation Standard Specifications for Highway and Structure Construction, 1996 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

B. Asphalt Institute:
1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.

C. American Society for Testing and Materials:

1. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
2. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit product information and mix design.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Standard Specifications, Section 405.

B. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphaltic Concrete Pavement Type E-1 with a PG58-28 Binder: As specified in the Standard Specifications.
1. Lower layer pavement nominal aggregate size: 19.0 mm
2. Upper layer pavement nominal aggregate size: 12.5 mm
3. Tack Coat shall be MS2 asphalt emulsion diluted with an equal amount of water and applied at a rate of 0.05 gallons per square yard.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted subgrade and base course subbase is dry and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

D. Verify gutter drainage grilles and frames and manhole frames are installed in correct position and elevation.

3.2 SUBBASE

A. Aggregate Subbase: Install as specified in Section 02721.

3.3 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt binder course within 24 hours of applying primer or tack coat.

B. Place binder course to compacted thickness shown on the Drawings.

C. Place surface course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing surface course, clean surface and apply tack coat before placing surface course.

D. Place surface course to compacted thickness shown on Drawings.

E. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.4 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

C. Scheduled Compacted Thickness: Within 1/4 inch.

D. Variation from Indicated Elevation: Within 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Take samples and perform tests in accordance with the Standard Specifications.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Protecting finished work.

B. Immediately after placement, protect pavement from mechanical injury until Final Completion.

END OF SECTION

SECTION 02750

RIGID PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete sidewalks and mow strips.
2. Concrete stair steps.
3. Concrete integral curbs and gutters.
4. Concrete parking areas and approach slabs.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:
1. Basis of Measurement: By square foot or square yard.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing where required, and compacting.

B. Concrete Pavement:
1. Basis of Measurement: By square foot or square yard.
2. Basis of Payment: Includes forms, reinforcement, concrete, accessories, placing, finishing, curing, and testing.

1.3 REFERENCES

A. State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, 1996 Edition, with most recent Supplemental Specifications, hereinafter referred to as the Standard Specifications.

B. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. American Society for Testing and Materials:
1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
2. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
3. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM C33 - Standard Specification for Concrete Aggregates.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

8. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
9. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
10. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
11. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit joint filler product information and mix design..

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of the Standard Specifications, Section 415.

B. Obtain cementitious materials from same source throughout.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: As specified in Section 03100.

B. Joint Filler: ASTM D1751 resilient bituminous type; thickness as shown on the Drawings.

2.2 REINFORCEMENT

A. Reinforcing Steel and Wire Fabric: Type specified in Section 03200.

2.3 CONCRETE MATERIALS

A. Concrete Materials: As specified in Section 00900.

2.4 ACCESSORIES

A. Curing Compound: Standard Specifications, Section 415.
1. Liquid Membrane – Forming Compounds per section 415.2.5.1 shall be used.

B. Joint Sealers: Specified in Section 07900.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted subgrade and base course is acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

3.2 BASE COURSE

A. Aggregate Base Course: Install as specified in Section 02721.

3.3 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole, catch basin and imbedded frames with oil to prevent bond with concrete pavement.

C. Notify Architect/Engineer minimum 24 hours prior to commencement of concreting operations.

3.4 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

A. Place reinforcement at mid-height for sidewalks and mowstrips, top and bottom for concrete pavement and slabs-on-grade.

B. Interrupt reinforcement at expansion joints.

C. Place reinforcement to achieve pavement and curb alignment as detailed.

3.6 PLACING CONCRETE

A. Place concrete as specified in Section 03300.

3.7 JOINTS

A. Place contraction joints at same intervals as walk width. Align curb, gutter, and sidewalk joints.

B. Place joint filler between paving components and building or other appurtenances.

C. Provide joints between sidewalks and curbs, between curbs and pavement, and between pavement and structures as shown on the Drawings.

3.8 FINISHING

A. Area Paving: Light broom and trowel joint edges.

B. Sidewalk Paving: Light broom, and trowel joint edges.

C. Curbs and Gutters: Light broom.

D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.9 JOINT SEALING

A. Separate pavement from vertical surfaces with joint filler, ½ inch thick unless shown otherwise.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

C. Extend joint filler from bottom of pavement to within 1/8 inch of finished surface.

3.10 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

C. Maximum Variation From True Position: 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.

C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.12 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

END OF SECTION

SECTION 02923

LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

B. Final grade topsoil for finish landscaping.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures

B. Samples: Submit, in air-tight containers, 30 lb sample of topsoil fill to testing laboratory.

C. Analyze to ascertain percentage of nitrogen, phosphorous, potash, soluble salt content, organic matter content, and pH value.

D. Materials Source: Submit name of imported materials source.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: From stockpile as specified in Section 02311.
   1. Excavated and reused material. Select.
   2. Graded
   3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.
      a. Screening: single screened.

B. Topsoil: Imported
   1. Imported borrow
   2. Natural, friable loam
   3. Reasonably free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
      a. Screening: single screened.
   4. Acidity range (pH) of 5.5 to 7.5.
   5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify building and trench backfilling have been inspected.

C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, and stones in excess of 1 inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

A. Provide single screening of all topsoil to remove rocks, debris, roots, weeds, and foreign matter prior to placement.

B. Place topsoil in areas where seeding, sodding, and planting, is required. To thickness as scheduled (4 inches minimum). Place topsoil during dry weather.

C. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

D. Remove roots, weeds, rocks, and foreign material while spreading.

E. Manually spread topsoil close to plant material, buildings, and trees to prevent damage.

F. Lightly compact placed topsoil.

G. Remove surplus subsoil and topsoil from site.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

A. Compacted topsoil thicknesses:
   1. Seeded Grass: 6 inches minimum. All excess topsoil shall remain onsite. Uniformly spread excess topsoil onsite in areas as directed by Owner or Engineer.
   2. Sod: 4 inches.
   3. Shrub Beds: 18 inches.
   4. Landscape Berms: 12 inches.

END OF SECTION

SECTION 02924

SEEDING AND SOIL SUPPLEMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Seeding and Hydroseeding.
2. Mulching.
3. Soil testing and fertilizer.
4. Maintenance.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassed Areas:
1. Basis of Measurement: By square yard.
2. Basis of Payment: Includes preparation of subsoil, topsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.3 REFERENCES

A. American Society for Testing and Materials:
1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.5 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.
1. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.7 QUALITY ASSURANCE

A. All seed shall conform to the requirements of the Wisconsin Statutes and the Wisconsin Administrative Code Chapter ATPC 20 regarding noxious weed seed content and labeling.

B. Provide grass seed mixtures in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

C. Prairie seed mix shall be grown in Wisconsin or northern Illinois. It shall list all species and varieties included in the mix.

D. Prairie seed mixtures shall be provided in containers showing percentage seed mix, inert matter, net weight, year of production, date and location of packaging.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Deliver grass seed mixtures and prairie seed in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.9 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

1.10 MAINTENANCE SERVICE

A. Section 01700 - Execution Requirements: Requirements for maintenance service.

B. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for two cuttings.

PART 2 PRODUCTS

2.1 SEED MIXTURES

A. Provide three (3) different seed mixtures in accordance with schedule herein.

B. Seed Mixture 1

1. The seed mixture is WDOT Mixture No. 10 as described in the State Specifications. This mixture shall be used within street rights of way and on the lift station site outside areas specified for “No Mow” seeding.

C. Seed Mixture 2

1. The seed mixture is a proprietary mix, called "No Mow" Lawn Mix, a specially designed blend of six low-growing Fine Fescue turf grasses from Prairie Nursery, Westfield WI. It can be substituted by "Eco-Grass" from Prairie Moon Nursery, in Winona, MN. This mixture shall be used on all slopes exceeding 3H to 1V.

D. Seed Mixture 3

1. The seed mixture called "Short Grass Prairie for Medium Soils, containing at least 15 wildflowers and 2 or more grasses from Prairie Nursery, Westfield, WI. It can be substituted by "Short Grass Prairie for Mesic Soils", item #SGM, containing at least 20 prairie forbs and 5 grasses, from Prairie Moon Nursery in Winona, MN. This mixture shall be used for restoration along the 18" interceptor sewer route depicted on sheets 26-C-1 through and including 26-C-3.

2.2 SOIL MATERIALS

A. Topsoil: As specified in Section 02923.

2.3 ACCESSORIES

A. Mulching Material: Pennmulch Seed Accelerator with Starter Fertilizer shall be provided as mulch for seed mix #1. Dry oat, wheat straw or marsh hay, free from weeds and foreign matter detrimental to plant life are acceptable for seed mixes 2 and 3. Hay or chopped cornstalks are not acceptable.

B. Hydroseeding Mulch: Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.

C. Tackifier: Arn-Tak manufactured by American Excelsion, or equal. Emulsion designed to retain moisture and heat in the soil. Mulch shall be chemically inert, nontoxic to plants, humans, and animals.

D. Fertilizer: FS O-F-241, Grade A; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis.

E. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, if indicated in soil analysis.

F. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

G. Erosion Mat: As Specified in Section 01500.

H. Stakes: Softwood lumber, chisel pointed.

I. String: Inorganic fiber.

J. Edging: Galvanized steel.

2.4 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

C. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

D. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work

B. Verify prepared soil base is ready to receive the Work of this section. Refer especially to required conditions for seeding of prairie and No Mow Lawn Mix as specified by Prairie Nursery.

3.2 FERTILIZING

A. Apply lime at application rate recommended by soil analysis.

B. Apply fertilizer at application rate recommended by soil analysis.

C. Apply after smooth raking of topsoil and prior to roller compaction.

D. Do not apply fertilizer at same time or with same machine used to apply seed.

E. Mix fertilizer thoroughly into upper 3 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 METHOD

A. The areas to be seeded shall be worked with discs, harrows and other appropriate equipment until a reasonable even and loose bed is obtained immediately in advance of seeding.

B. The seed mixture shall be sown by means of equipment adapted for the purpose, or it may be scattered uniformly by hand and lightly raked or dragged over the area to cover the seed with approximately 6mm of soil.

C. After seeding the areas shall be lightly rolled or compacted by suitable equipment, if the in the judgment of the Landscape Architect, the seedbed is either too loose or contains clods which would reduce the germination of the seed.

3.4 SEEDING RATES

A. For seed mix #1, apply seed at rate of at least 4 lbs per 1000 sq.ft.; for seed mix # 2 apply at least 5 lbs per 1000 sq. ft.; for seed mix #3 apply at least 1/2 lb. per 1000 sq. ft.. Distribute evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season: May 1 to June 15; August 15 to October 1. For "No Mow Lawn Mix" Aug. 15 to Oct. 1 is the preferred planting season.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Immediately following seeding, apply mulch. Hay and straw mulch shall not be used for seed mixture 1. Maintain clear of shrubs and trees.

F. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.5 HYDROSEEDING

A. Provide hydroseeding mulch for seed mix #1; use of hay or straw mulch is not allowed.

B. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at specified rates evenly in one pass.

C. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.6 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 8 inches. Space stakes at 36 inches.

B. Cover seeded slopes with erosion mat as shown on drawings. Roll mat onto slopes without stretching or pulling.

C. Install erosion mat as shown on the drawings. Lay mat smoothly on surface, bury top end of each section in deep excavated topsoil trench. Overlap edges and ends of adjacent. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between mat and soil.

F. At sides of ditches, lay mat laps in direction of water flow. Lap ends and edges minimum 10 inches.

3.7 MAINTENANCE

A. Mow grass (seed mix #1) at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary. Roll surface to remove minor depressions or irregularities.

C. Use mulching mower leaving finely chopped clipping on the lawn. Do not let clippings lay in clumps.

D. For maintenance of "No Mow Lawn" and Prairie areas follow maintenance instructions by the seed supplier.

E. Water regularly and uniformly during plant establishment to prevent soil and plants from drying out.

F. Control growth of weeds. Apply selective herbicides according to instructions on label on lawn areas only. Remedy any damage resulting from improper use of herbicides

G. Control growth of weeds in prairie according to recommendation by Prairie Nursery.

H. Immediately reseed areas showing bare spots.

I. Repair washouts, gullies and any damage from unauthorized traffic.

J. Protect seeded areas with warning signs during maintenance period.

3.8 SEED SCHEDULE

A. Seed Mixture 1: As indicated in Section 2.1.

B. Seed Mixture 2: As indicated in Section 2.1.

C. Seed Mixture 3: As indicated in Section 2.1.

END OF SECTION

SECTION 02930

EXTERIOR PLANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Topsoil bedding.
2. Trees, plants, and ground cover.
3. Mulch.
4. Fertilizer.
5. Pruning.
6. Maintenance.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A300 - Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices.
2. ANSI Z60.1 - Nursery Stock.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit list of plant material sources, data for fertilizer and other accessories.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Include pruning objectives, types and methods; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

A. Unless otherwise specified, all plants shall be nursery grown stock.

B. All plants shall be typical of their species and have well formed tops and root systems and shall be free from injurious insects, plant diseases or other pests. Plants furnished shall be free from defects, including serious injuries to top, branches, trunk, bark or roots, dried out roots, prematurely opened buds, thin or poor tops or root systems, evidence of mold, dry, loose or broken ball of earth in B& B stock, dried out or damaged soil mass in CG stock.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. All plant stock shall be dug and handled with care and skill to prevent injuries to the trunk, branches and roots, and shall be packed in an approved manner to insure arrival at the project site in good condition.

D. The plant stock shall be transported in an enclosed vehicle or, in lieu of the enclosed vehicle, the plant tops shall be suitably protected from drying.

E. Bare root stock (BR) shall be moved with the roots protected against drying out by the use of moist sphagnum moss, straw or other suitable material and covered with canvas or other suitable covering material.

F. Balled & Burlapped stock (B&B) shall be moved with a compact dug ball of earth so firmly wrapped in burlap that upon delivery the soil in the ball is still firm and compact about the small feeding roots. Each ball shall be of sufficient size to encompass all the fibrous feeding roots necessary to insure successful recovery and development of the plant.

G. Container grown stock (CG) shall be well rooted and established in the container in which they are growing. They shall grown in the container sufficiently long so that the root soil mass will retain its shape when removed from the container, but not so long that the plant has become container bound.

H. All plants furnished with earth balls or in containers shall be handled by the ball or container.

I. Deliver plant life materials immediately prior to placement. Keep plants moist. Protect and maintain plant life until planted

J. Plant material damaged as a result of delivery, storage or handling will be rejected.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

C. Do not install plant life when wind velocity exceeds 30 mph.

D. Fall evergreen planting shall be completed between Sept. and Oct. 1.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

1.11 MAINTENANCE SERVICE

A. Section 01700 - Execution Requirements: Requirements for maintenance service.

B. Maintain plant life for one year after Date of Substantial Completion.

C. Maintain plant life immediately after placement until plants are well established and exhibit vigorous growing condition. Continue maintenance for a minimum of 60 days or until final acceptance, whichever is longer.

D. Maintenance includes:
1. Cultivation and weeding plant beds and tree pits.
2. Applying selective herbicides for weed control for seed mixes #1 and #2 in accordance with instructions on the label. Remedy damage resulting from use of herbicides.
3. Remedy damage from use of insecticides.
4. Irrigating sufficient to saturate root system.
5. Pruning, including removal of dead or broken branches, so that the plant retains its natural form.
6. Disease control.
7. Maintaining wrapping, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.
8. Replacement of mulch.

PART 2 PRODUCTS

2.1 TREES, PLANTS, AND GROUND COVER

A. Planting Stock:
1. Species: In accordance with Standardized Plant Names, official code of American Joint Committee on Horticulture Nomenclature.
2. All plants shall be true to name.

3. Identification: Label individual plants or bundles of plants legibly and securely with name and size.
4. Plants: No. 1 Grade conforming to “American Standard for Nursery Stock” of American Association of Nurserymen (AAN); well-branched, vigorous and balanced root and top growth; free from disease, injurious insects, mechanical wounds, broken branches, decay and other defects.
5. Trees: Furnish with reasonably straight trunks, well balanced tops, and single leader.
6. Deciduous plants: Furnish in dormant state, except those specified as container grown.

B. Trees, Shrubs and Ground Cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.2 PLANT INSPECTION, APPROVAL AND SUBSTITUTION

A. All plant material shipment and deliveries shall comply with State and Federal Laws and regulations including Wisconsin Administrative Code, Chapters ATCP 21 governing the inspection, shipping, selling and handling of plant stock. A tag or label bearing the name and address of the license nurseryman shall accompany each shipment of plant material and shall be filed with the landscape architect/engineer upon arrival of the plant material at the project site.

B. The contractor shall furnish the landscape architect/engineer a written list of sources from which the contractor proposes to obtain plant materials for the project. Such list shall be furnished at least 15 days prior to the date that such plant materials are to be delivered to the project site.

C. All plants shall be subject to the approval of the landscape architect/engineer.. Plants may be inspected at the grower’s nursery or at the place of collection. Representative plants may be tagged at the grower’s nursery.

D. Approval of plants at the source does not alter the right of rejection at the project site.

E. All rejected plants shall be replaced with acceptable plants of the same species, variety and size, unless otherwise directed by the landscape architect/engineer.

F. Where evidence is submitted that a specified plant cannot be obtained, substitution can be made, only upon specific approval by the landscape architect/engineer.

2.3 SOIL MATERIALS

A. Topsoil: As specified in Section 02923.

2.4 SOIL AMENDMENT MATERIALS

A. When soil tests indicate soil amendment, apply soil conditioners or fertilizers to amend soil to specified conditions.

1. Tree Fertilizer: FS O-F-241, Type I, Grade A, containing fifty percent of elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis.

B. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

C. Bone Meal: Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

D. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

E. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of plants.

2.5 MULCH MATERIALS

A. Mulching Material: Composted, shredded hardwood bark, dark brown in color.

2.6 ACCESSORIES

A. Wrapping Materials: Wrapping, when specified, shall consist of a two-ply water-proofed crepe tree wrapping paper, laminated with a layer of pliable asphalt material.

B. Stakes: Softwood lumber, pointed end.

C. Cable, Wire, Eye Bolts and Turnbuckles: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches.

E. Rodent protection shall consist of aluminum or other metal commercial window screening material.

2.7 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing, inspection and analysis requirements.

B. Test and analyze topsoil.

C. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter; pH value.

D. Provide recommendation for fertilizer and soil amendment application rates for specified planting as result of testing.

E. Testing is not required when recent tests are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify prepared subsoil are ready to receive work.

C. Saturate soil with water to test drainage.

D. Verify required underground utilities are available, in proper location, and ready for use.

3.2 FERTILIZING

A. Apply starter fertilizer in accordance with nursery instructions.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 3 inches of topsoil.

D. Lightly water soil to aid dissipation of fertilizer.

3.3 SITE LAYOUT

A. Location of plant holes or beds will be staked out by the landscape architect/engineer. Provide at least one week notice prior to planting.

3.4 EXCAVATION OF PLANT HOLES

A. The plant holes shall be centered at the location stake, unless otherwise permitted by the landscape architect/engineer.

B. The depth of the plant hole shall equal the height of the root ball or container, so that the root flare will be planted at ground level when the plant is in the final position, except that in heavy clay soils, the root flare shall be 2” above the ground level after planting.

C. The width of the planting hole shall be at least twice the width of the root ball or container to allow the roots to be spread out to grow away from the trunk.

3.5 PLANTING

A. Place plants for best appearance for review and final orientation by landscape architect/engineer.

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Prepare plant mix (Backfill) as uniform mixture of 1 part peat with 3 parts topsoil by volume.

E. Set plants in pits or beds, partly filled with prepared plant mix, at minimum depth as indicated on Drawings under each plant. Remove burlap, ropes, and wires, from top half of root ball per nursery directions.

F. Place bare root plant materials so roots lie in natural position. Backfill soil mixture in 6-inch layers. Maintain plant life in vertical position.

G. Saturate soil with water when pit or bed is half full of topsoil and again when full.

3.6 MULCHING

A. Wood chip mulch shall be spread over the planted berm and the individually planted trees to a depth of 3-4”. No mulch shall touch the trunk of newly planted trees.

B. Shredded hardwood mulch of uniform size shall be placed over newly planted shrub beds to a depth of 2-3”.

3.7 PLANT SUPPORT

A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:

Tree Caliper	Tree Support Method
1 inch	1 stake with one tie
1 – 2 inches	2 stakes with two ties
3 – 4 inches	3 guy wires [with eye bolts and turn buckles]
Evergreens	3 guy wires [with eye bolts and turn buckles]

3.8 TREE PRUNING

A. When pruning trees is required, lightly prune trees in accordance with ANSI A300 Maintenance Pruning Type: Crown Cleaning.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIAL

A. All excess excavation, waste materials, or other debris shall be removed and disposed of by the contractor.

3.10 PLANT CARE

A. The contractor shall properly care for all plants from the time of planting until the partial or final acceptance of the work under the contract.

B. Proper care of plants shall consist of doing such watering, weeding, pruning, spraying, tightening of braces and guys, remulching and any other work as may be necessary to keep the plants in a healthy condition.

C. All evergreens that die during the plant establishment period of one year shall be removed and disposed of by the contractor.

D. Any plants that die during the plant establishment period of one year shall be replaced at the contractor's expense at the earliest appropriate planting time.

E. All bracing and guying materials shall be removed and disposed of by the contractor after the final inspection of the plantings.

3.11 INSPECTION AND ACCEPTANCE

A. The final acceptance of the planting will be made at the end of the warranty period (1 year from completion of work) with the owner or owner's representative, the contractor and landscape architect/engineer.

B. Only those plants that are in a healthy growing condition and meet the minimum requirements of the WIS. D.O.T. Standard Specification, Section 632.3, will be accepted.

C. WARRANTY

3.12 The standard warranty is for one (1) year period, excluding bulbs, annuals and perennials commencing on the date of Substantial Completion. All plants shall be alive and in satisfactory growth at the end of the warranty period.

A. Any plant that is 25% dead or more shall be considered dead and must be replaced at no charge. A tree is considered dead when the main leader has died back, or 25% of the crown is dead.

3.13 REPLACEMENT

A. Replacements shall be made during the next planting season.

B. The Landscape contractor shall be responsible for a one-time replacement only.

C. Replacements shall be of the same type, size and quality as the originally specified species, unless otherwise negotiated with the landscape architect/engineer.

D. The landscape contractor shall not be responsible for plant material that has been damaged by vandalism, wildlife, theft, improper maintenance or other activities beyond the contractor's or owner's control.

3.14 SCHEDULE - PLANT LISTS

Qty.	Common Name	Scientific Name	Size at planting	Condition	Height	Spread
11	Nigra American Arborvitae	Thuja occidentalis 'Nigra'	6’	BB	25’	10’
12	Serbian Spruce	Picea omorika	7’	BB	55’	25’

Note: Ultimate height and spread approximate.

END OF SECTION

SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes formwork for cast-in place concrete, with shoring, bracing, and anchorage; openings for other work; form accessories; and form stripping.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.
5. ACI 350 – Environmental Engineering Concrete Structures

B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. American Society for Testing and Materials:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

E. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to applicable code requirements; resultant concrete to conform to required shape, line and dimension as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 350, 347, 301, and 318.

B. For wood products furnished for work of this Section, comply with applicable provisions of AF&PA National Design Specifications for Wood Construction.

1.5 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Structural Engineer experienced in design of this Work and licensed in the State of the Project Location.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Products storage and handling requirements.

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

C. After formwork is placed, verify that there is sufficient concrete cover over the reinforcement. If there is insufficient concrete cover, request instructions from Architect/Engineer.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood: Douglas fir or Spruce species; select sheathing, tight face grade; sound undamaged sheets with clean, true edges.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, fixed length, cone type, with waterproofing washer, 1 inch back break dimension, free of defects capable of leaving holes larger than 1-1/4 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Corners: Fillet or Chamfer, wood strip type; 3/4 inch x 3/4 inch.

D. Flashing Reglets: Rigid PVC, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Vapor Retarder: Where shown on Drawings, 10 mil thick polyethylene sheet.

F. Joint Filler: As specified in Section 03251.

G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

H. Water Stops: As specified in Section 03251

2.4 COATINGS

A. Coatings for Aluminum:
   1. Conlux:
      a. Primer: Bond Plex 46 or 66 (water-borne urethane).
      b. Top Coat: Epolon Multi-Mil 39 (epoxy polyamide).
   2. Sherwin Williams: Topcoat of Heavy Duty Epoxy B67-B60B3 (epoxy polyamide). Note: Self-priming.
   3. Benjamin Moore:
      a. Primer: Epoxy Rust-Inhibitive Primer (epoxy polyamide).
      b. Top Coat: Epoxy Enamel (epoxy polyamide).

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

3.2 EARTH FORMS

A. Earth forms are not permitted.

3.3 INSTALLATION

A. Formwork - General:
   1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
   2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
   4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
   5. Complete wedging and bracing before placing concrete.

B. Forms for "Smooth Finish" Concrete:
   1. Use steel, plywood or lined board forms.
   2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
   3. Install form lining with close-fitting square joints between separate sheets without springing into place.
   4. Use full size sheets of form lines and plywood wherever possible.
   5. Tape joints to prevent protrusions in concrete.
   6. Use care in forming and stripping wood forms to protect corners and edges.
   7. Level and continue horizontal joints.
   8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:
   1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
   2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
   3. Construct beam soffits of material minimum of 2 inches thick.
   4. Distribute bracing loads over base area on which bracing is erected.
   5. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Architect/Engineer's approval before framing openings in structural members that are not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, columns, walls and slabs.

I. Install void forms in accordance with manufacturer's recommendations.

J. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

H. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.

4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Securely anchor embedded items in correct location and alignment prior to placing concrete.
4. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318, Section 6.3.

L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where shown on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:
1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

3.7 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Forming shall remain in place for at least the minimal time recommended by ACI 347R. In addition, forming for horizontal members such as elevated slabs and beams shall remain in place a minimum of 7 days. In no case shall forming of horizontal members be removed before the concrete has reached at least 70% of its specified design strength.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Reshore areas as required to carry additional imposed loads.

D. Repair damage to structure caused by early removal of forming and shoring at no additional cost to Owner.

E. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

F. See Section 03300 for additional requirements.

3.9 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

C. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes reinforcing steel bars, welded wire fabric and reinforcement accessories for cast-in-place concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 350 – Environmental Engineering Concrete Structures
4. ACI SP-66 - ACI Detailing Manual.

B. American Society for Testing and Materials:
1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Section 01300 – Submittals: Procedure for Submittals.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
1. Coordinate bar splicing and placement with CONTRACTOR’S concrete placing schedule and joint locations.
2. Submit with construction joint submittals required in Section 03300.

C. Dowel bar splicer system, reinforcing bar splicer laboratory reports and manufacturer's product data.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Welders: AWS qualification within previous 12 months.

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, unfinished.
   1. If reinforcement is to be welded, Deformed Reinforcement: ASTM A706/A706M; 60 ksi yield strength, steel bars, unfinished shall be used.

B. Welded Plain Wire Fabric: ASTM A185; in flat sheets; unfinished.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel or Stainless steel type; size and shape as required for Project conditions.

D. Dowel Bar Splicer: ASTM A615, 60 ksi deformed rebar material; the completed splice shall meet 125% specified yield stress. Use "Dowel Bar Splicer (DB-SAE) and Dowel-In (DI) manufactured by Dayton/Richmond or approved equal.

E. Reinforcing Dowel Epoxy: ASTM C881, Two component, high-solids, epoxy-based anchoring adhesive formulated for optimum performance in both cracked and uncracked concrete. Hilti HY200 by Hilti Corporation; SET-XP by Simpson Strong Tie; P110+ by Powers Fasteners; or approved equal.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

B. Fabricate column reinforcement with offset bends at reinforcement splices.

C. Weld reinforcement in accordance with AWS D1.4.

D. Locate reinforcement splices not indicated drawings, at point of minimum stress. Review location of splices with Architect/Engineer.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   1. Do not weld crossing reinforcement bars for assembly except as permitted by Architect/Engineer.

B. Do not field bend bars, including bars partially embedded in concrete, unless indicated.

C. Do not place bars having kinks and bands other than shown on the Approved Shop Drawings.

D. Do not displace or damage vapor retarder.

E. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.

F. Reinforcement shall be continuous through construction joints
   1. Reinforcement may be spliced at construction joints provided that the entire lap is placed within one concrete pour.

G. Extend welded wire fabric to within 2 inches of edges of slab or section. Lap sheets at least 12 inches or 2-wire spaces, whichever is greater at ends and edges and wire together. Stagger end laps.

H. Accommodate placement of formed openings.

I. Space reinforcement bars with minimum clear spacing of one bar diameter, but not less than 1 inch.
   1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

J. Unless otherwise indicated on drawings, conform to ACI 350 for concrete cover over reinforcement.

K. Dowel bar splicer systems may be substituted for dowels at CONTRACTOR's option when approved by Engineer.

L. Reinforcing bar splicers may be substituted for lapped splices at CONTRACTOR'S option when approved by engineer.

M. Drill and epoxy dowels as shown on the plans. Follow epoxy manufacturer's recommendation for drill hole size, preparation, cleaning, and applying epoxy. Provide embedment depth as shown on drawings, 6" minimum if not indicated otherwise.

3.2 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

3.3 FIELD QUALITY CONTROL

A. Section 01400 – Quality Control: Field inspection and testing.

END OF SECTION

SECTION 03251

CONSTRUCTION, EXPANSION AND CONTRACTION JOINTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Forming integral construction, contraction and control joints in concrete.

B. Visually concealing expansion joints in concrete.

1.2 REFERENCES

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

B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

E. ASTM D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

1.3 SUBMITTALS

A. Provide 6-inch long sample of expansion and contraction joint under provisions of Section 01300.

B. Provide 6-inch long sample of all cast-in type waterstops to be used on the Project under provisions of Section 01300.

C. Submit manufacturer's installation instructions under provisions of Section 01300.

1.4 QUALITY ASSURANCE

A. Pre-Concrete Placement Inspection
   1. All waterstop joints shall be subject to strict inspection. Waterstops that are damaged, not firmly secured, in the wrong location, or improperly spliced will be rejected.
   2. Notify Engineer a minimum of 24 hours prior to the commencement of concrete placement.
   3. Allow Engineer to inspect all waterstops before formwork is erected if the formwork will impede inspection.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store waterstops and joint materials under tarps and off of ground to protect from oil, dirt, water and sunlight.

PART 2 PRODUCTS

2.1 INTEGRAL JOINT MATERIALS

A. General: All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Ribbed with Center Bulb Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; flat profile; ribbed flaps; large center bulb; 4-inch, 6-inch or 9-inch wide. Style 701, 732 or 735 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

C. Retro-Fit Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; Style 667, 609 or 581 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

D. Labyrinth Profile Waterstop: PVC, minimum 1750 psi tensile strength, low temperature brittleness minus 35 degrees F; Style 790 or 789 as manufactured by Greenstreak Plastics Products, or approved equal.
   1. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

E. Pre-formed Hydrophyllic Waterstop: Hydrophyllic (bentonite-free) waterstops shall be Hydrotite CJ10202K as manufactured by Greenstreak Plastic Products Co., Sikaswell-S by Sika Corp, or approved equal.

F. Joint Filler: ANSI/ASTM D1752, Type 1, closed-cell neoprene, fully compressible with recovery rate of minimum 95 percent, as manufactured by W.R. Meadows or approved equal.

G. Joint Filler: ANSI/ASTM D 1622/3575, "DECK-O-FOAM" closed-cell polyethelene, fully compressible with recovery rate of minimum 95 percent, as manufactured by W.R. Meadows or approved equal.

2.2 SEALANTS

A. Sealant and Primer: Specified in Section 07900.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate and form construction, expansion, control, and contraction joints.
   1. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer.
   2. Limit size of concrete pours. Maximum length of wall and slab pours shall not exceed 60 feet.
   3. Locate construction joints in floors within the middle third of the span. Construction joints in floors supported by walls may be located at the center of wall with Engineer's approval.
   4. Construction joints in beams shall be offset a minimum distance of 2 times the width of intersecting beams.
   5. Locate vertical construction joints in walls a minimum of one-half the wall height from corners or other intersecting walls or at midpoint between corners orf intersecting walls. Locate horizontal joints in wall within middle third of wall height.
   6. Make control joints in slabs on grade of preformed control joint strips set flush with finished surface, by construction joint, by tooled joint or cut a minimum 3/16" wide joint with a diamond saw within 12 hours after concrete placement.
      a. Cut alternate reinforcing bars or wires crossing joint
      b. Provide preformed control strip in full length unspliced pieces unless a special splice designed to prevent misalignment of splice joint is used.
      c. Control joints shall be ¼ depth of slab, unless shown otherwise on Drawings.
      d. Fill construction joint, tooled joint and sawed joints with epoxy joint filler.

B. Provide waterstop in construction joints in:
   1. Walls and slabs separating dry interior from earth or liquid.
   2. Exterior walls of liquid holding tanks
   3. Floor slabs above occupied areas
   4. Other locations shown on the Drawings.

C. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.
   1. Tie plastic waterstop to reinforcing steel at 24 inches on center with a minimum 16 gage tie wire to prevent movement when placing concrete. When waterstop is to be formed into the formwork the plastic waterstop shall be secured to the form work to prevent movement. "Mucking" or setting waterstop into wet concrete after concrete placement will not be allowed.

D. Use Hydrophyllic waterstops only where noted on Drawings. Fasten, nail, or screw and apply per manufacturers recommendations.

E. Place formed construction joints in floor slab and walls to facilitate pattern placement sequence. Set top screed to required elevations for floor slabs. Secure to resist movement of wet concrete.

F. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

G. Apply sealants in accordance with Section 07900.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place structural concrete, fill concrete, building frame members, floors, shear walls, foundation walls, and supported slabs.

B. Floors and slabs on grade.

C. Equipment pads, light pole bases, thrust blocks, and miscellaneous concrete work.

D. Non-shrink grout, high precision grout, patching mortar, and grout for clarifier floor.

E. Control, expansion and contraction joint devices.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306.1 - Standard Specification for Cold Weather Concreting.
5. ACI 318 - Building Code Requirements for Structural Concrete.
6. ACI 350 - Environmental Engineering Concrete Structures.

B. American Society for Testing and Materials:
1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C595 - Standard Specification for Blended Hydraulic Cements.

13. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
14. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
15. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
16. ASTM 1077 - Practice for Laboratories Testing Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
17. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
18. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
19. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
20. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
21. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
22. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
23. ASTM E1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on attachment accessories, admixtures, non-shrink grout and high precision grout, patching mortar and accessories.

C. Furnish submittals in accordance with ACI 301 including mill tests for cement, admixture certification (including chloride ion content), aggregate gradation test results and certification, materials and methods for curing, quality-control program of the concrete supplier.

D. Design Data:
1. Submit concrete mix design for each concrete strength to be used on the project. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

E. Delivery Tickets: When ready mixed concrete is used, the Contractor shall furnish delivery tickets, with the information stated in Sections 15.1 and 15.2.8 of ASTM C94, with each batch of concrete before unloading at the site. Recording of revolution counter is required.

F. Product Data: Submit data on joint devices, attachment accessories, admixtures, non-shrink grout and high precision grout, patching mortar and accessories.
   1. High Range Water Reducer: Submit intended use area with product data and mix design.

G. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

H. Provide test data on fly ash for each truck load of fly ash delivered for use on this project, conforming to ASTM C618, including the requirements of Tables 1 through 3 and optional requirements.

I. Construction Joints: Sequence of placing concrete, location and details of joints, openings and embedded items not shown on Drawings. Coordinate sequence of placement and joint locations with reinforcement Shop Drawings. Submit reinforcement submittals as required in Section 03200.

J. Control Joints in slabs-on-grade: Locations and details of joints.

K. Test Results:
   1. Concrete test results.
   2. With each load of concrete delivered, provide duplicate delivery tickets, one for CONTRACTOR and one for ENGINEER, with the following information.
      a. Date and serial number of ticket.
      b. Name of ready mixed concrete plant, operator, and job location.
      c. Type of cement, admixtures, if any, and brand name.
      d. Cement content, in bags/cu yd of concrete, and mix design.
      e. Truck number, time loaded, and name of dispatcher.
      f. Amount of concrete in load, cu yds, delivered.
      g. Maximum size aggregate.
      h. Gallons of water added at job, if any, and slump of concrete after water was added.
      i. Temperature of concrete at delivery.
      j. Time unloaded.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with the standards of the State in which the project is located.

C. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, catching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.

D. Concrete Testing: Testing shall be provided by CONTRACTOR in accordance with Section 01400 and this section.
   1. Test concrete and sample material in accordance with applicable ASTM methods listed below.
      a. Slump: ASTM C143.
      b. Air-Entrainment: ASTM C231.
      c. Compressive Strength Test: ASTM C31 (making and cylinder curing) and ASTM C39 (testing)

E. Approved of use of high range water reducer and non-chloride accelerator shall be used in accordance with manufacturer's recommended dosage range.

F. Evaluation and Acceptance of Concrete Strength:
   1. Evaluation and acceptance of concrete shall be according to ACI 318, Chapter 5 and as indicated herein.
   2. Analysis of compression test results shall be performed according to methods in ACI 214. Overall standard deviation of the test results shall not exceed 600 psi.

G. Acceptance of Structure:
   1. All concrete which does not meet the requirements, including strength, dimensional tolerances, appearance, durability of ACI 301 and these specifications is subject to removal at no cost to the Owner.
   2. Concrete members cast in the wrong location may be rejected.
   3. Formed surfaces resulting in concrete outlines that are smaller or larger than permitted by the tolerances of ACI 117 may be rejected.

H. Hot Weather:
   1. Comply with ACI 305
   2. Concrete temperature shall not exceed 90° F
   3. At air temperatures of 80° F or above, keep concrete as cool as possible during placement and curing.
   4. When concrete temperatures are expected to exceed 80° F during curing, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

I. Cold Weather:
   1. Comply with ACI 306.1
   2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35° F. Preheat if temperature is below 35° F.
   3. Maintain air and forms in contact with concrete sections having a minimum dimension of 12 inches or less at temperatures above 50° F for at least the first three days and at a temperatures above 32° F for the remainder of specified curing period

4. Maintain air and forms in contact with concrete in more massive sections at temperatures above 40° F for at least the first three days and at temperatures above 32° F for the remainder of specified curing period

1.6 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement for all hydraulic and below grade structures and sewers: ASTM C150, Type I - Portland type with Fly Ash or Slag or Type II - Moderate Sulfate Resistant.

B. Cement for non-hydraulic and above grade structures: ASTM C150, Type I or Type II - Moderate Sulfate Resistance, Portland type.

C. Fine and Coarse Aggregates: ASTM C33.

D. Normal Weight Aggregates: ASTM C33.
1. Coarse Aggregate Maximum Size: 1 1/2 inches in accordance with ACI 318.

E. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260; Daravair by W.R. Grace; MicroAir by Master Builders; Sika AEA-15 by Sika Corp; or approved equal.

B. Chemical: ASTM C494
1. Type A - Water Reducing; WRDA with Hycol or WRDA-82 manufactured by W.R. Grace or approved equal.
2. Type D - Water Reducing and Retarding; Daratard-17 manufactured by W.R. Grace or approved equal.
3. Type F (or G) - Water Reducing, High Range; Daracem-100 manufactured by W.R. Grace; WRDA-19 manufactured by W.R. Grace; or approved equal.

C. Fly Ash: ASTM C618; Class C or Class F providing increased sulfate resistance equivalent to or better than Type II cement.

D. Slag: ASTM C989; Grade 120; ground granulated blast furnace slag.

E. Integral Corrosion Inhibitor: ASTM C494 Type C admixture that chemically inhibits the corrosive action of chlorides on reinforcing steel. DCI Corrosion Inhibitor by W.R.

Grace, Polychem CI by General Resource Technology, Inc. or approved equal. Dosage rate shall be as recommended by supplier.

F. Integral waterproofing admixture: Hydrophilic, crystalline admixture for waterproofing concrete. Admix C-500 by Xypex; Penetron by W.R. Grace; Kystol Internal Membrane by Kryton; ADI-CON Plus by W.R. Meadows; or Hycrete W500 by Hycrete, Inc.; or Approved equal. Add admixture to concrete in accordance with manufacturer's recommendations.

G. Synthetic Macro Fiber Reinforcement: ASTM C1116. High modulus synthetic macro fiber reinforcement that evenly distributes through concrete mix. Strux 90/40 by Grace Construction Products, Fibermesh 650 by Propex Global; Tuf-Strand SF by Euclid Chemical Company or approved equal. Apply fiber reinforcement to concrete mix to provide a minimum of 4 lbs per cubic yard, unless noted otherwise.

2.3 ACCESSORIES

A. Epoxy Bonding Agent:
   1. Non-sag type: Concressive Paste (SPL or LPL) by Master Builder, Sikadur 32 Hi-Mod Gel Epoxy Adhesive by Sika Corp; or approved equal.
   2. Liquid Type: Concressive Liquid (LPL) by Master Builders; Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corp; or approved equal.

B. Vapor Retarder: As specified in in Section 03100.

C. Non-Shrink Grout: For steel column base plates and machine bases under 10 hp. ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 3,000 psi in 72 hours and 7,000 psi in 28 days.

D. High Precision Grout: For machine bases over 10 hp. Premixed compound consisting of metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 72 hours and 9,000 psi in 28 days; EMBECO 850 Grout manufactured by Master Builders or approved equal.

E. Grout for Clarifier Slabs: Screened sand, water, minimum 752 pounds of cement per cubic yard.

F. Concrete repair mortars: One component, polymer-modified, cementitious patching material. SikaRepair 222/223 by Sika Corporation; MasterEmaco S440 by BASF Corporation Construction Systems; Planitop 18 by Mapei Corporation, Patchcrete by Lyons Manufacturing, Inc. or approved equal.

G. Surface Applied Corrosion Inhibitor: Surface applied, impregnating coating for steel reinforced hardened concrete. Shall protect both anodic and cathodic parts of the corrosion cell. Sika FerroGard 903 by Sika Corporation; Mapeshield CI 100 by Mapei Corporation or approved equal.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler, Waterstops: As specified in Section 03251.

B. Sealant and Primer: As specified in Section 07900.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Option C.

1. Deliver and complete discharge within 1 ½ hours of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. This includes revolutions required by transit mix trucks. Limitations may be waived by Engineer if the concrete slump is within the allowable range, after the 1 ½ hours or the 300 revolutions limit is reached, and concrete can be placed without addition of water. In hot weather, time and/or revolutions criteria may be reduced by Engineer.
2. Do not add water on-site unless slump and water-cement ratio, after addition of water, are below the maximums allowed. If water is added on-site, mix concrete at site an additional 30 revolutions.
3. Deliver concrete to site having a temperature not less than 50 degrees F nor greater than 90 degrees F.
4. If high range water-reducing admixture is added on-site, mix concrete at site an additional 85 revolutions of drum after the addition of high range water-reducing admixture.

B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

C. Provide STRUCTURAL concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,000 psi
Water/Cement (fly ash) Ratio (maximum)	0.45 by weight
Cement plus fly ash (minimum)	525 lb/cubic yard
Aggregate Size (maximum)	1 inch
Air Entrained	4 to 6 percent
Admixture	Water reducing type
Slump	2 to 5 inches

D. Sides and bottoms of liquid containing structures such as tanks, clarifiers, wells, etc, provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,500 psi
Water/Cement (slag) Ratio (maximum)	0.42 by weight
Cement plus slag (minimum)	600 lb/cubic yard
Aggregate Size (maximum)	1 inch
Air Entrained	4 to 6 percent
Admixtures	Water reducing type Intergral Waterproofing
Slump	2 to 5 inches

E. Miscellaneous concrete and exterior slabs provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,000 psi
Compressive Strength (28 day)	3,000 psi
Water/Cement (slag) Ratio (maximum)	0.49 by weight
Cement plus slag (minimum)	475 lb/cubic yard
Aggregate Size (maximum)	1½ inch
Air Entrained	4 to 6 percent
Admixtures	Water reducing type Macro Fiber Reinforcement 4 lbs/c.y.
Slump	3 to 6 inches

F. Concrete topping slabs or slab-on-metal deck provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,000 psi
Water/Cement (slag) Ratio (maximum)	0.45 by weight
Cement plus slag (minimum)	515 lb/cubic yard
Aggregate Size (maximum)	¾” inch
Air Entrained	4 to 6 percent
Admixture	Water reducing type Macro Fiber Reinforcement 5 lbs/C.Y.
Slump	3 to 6 inches

G. Provide FILL concrete to the following criteria:

Unit	Measurement
Compressive Strength (28 day)	3,000 psi

H. Use accelerating admixtures in cold weather only when approved. Use of admixtures will not relax cold weather placement requirements.

I. Use calcium chloride only when approved by the Engineer.

J. Use set retarding admixtures during hot weather only when approved by the Engineer.

K. Add air entraining agent to normal weight concrete exposed to exterior. On surfaces to receive non-metallic hardener limit air content to 3% or less.

L. Concrete for soil backfill or utility backfill shall be Cementitious Controlled Low-Strength Material as specified in section 03320.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, clean holes, insert and grout steel dowels using epoxy bonding agent. Prepare holes and use bonding agent in accordance with Manufacturer's instructions.

C. Slope subgrade to floor drains to maintain the minimum slab thicknesses dimensioned on the Drawings.

D. Pitch slab and beam forms to match top slope of slab or beam to maintain thickness or depth noted on Drawings. As an alternate, the bottom of the slab or beam may be poured level provided that the minimum thickness or depth is maintained.

E. Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

F. Remove debris and ice from formwork, reinforcement and concrete substrates.

G. Subgrade and bedding shall be compacted and free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

H. Soak subgrade the evening before concrete placement and sprinkle ahead of placement of concrete.

I. Remove standing water, ice, mud and foreign matter before concrete is deposited.

J. Place joints in accordance with Section 03251.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301, ACI 318, and ACI 304.

B. Notify Architect/Engineer a minimum 24 hours prior to commencement of concrete placement operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
   1. Cast pipe and other embedded items into concrete as placement progresses. Do not provide block outs unless approved by Engineer.

D. Do not place ducts, conduits, pipes in slabs on grade. Place a minimum of 4 inches below bottom of slab.

E. Install vapor retarder under on-grade building floor slabs of occupiable (non-hydraulic) structures and at other locations indicated. Lap joints minimum 6 inches and seal watertight by sealant applied between overlapping edges and ends.

F. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; lap over damaged areas minimum 6 inches and seal watertight in accordance with ASTM E1643.

G. Separate slabs on grade from existing vertical surfaces with a 1/2 inch thick joint filler.

H. Place joint filler in floor slab as required by the sequence of placement. Set top to required elevations. Secure to resist movement by wet concrete.

I. Extend joint filler from bottom of slab to within a ½ inch of the finished slab surface. Conform to Section 07900 for finish and joint sealer requirements.

J. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

K. Place concrete continuously between predetermined expansion, control, and construction joints.
   1. Place in lifts not exceeding 24 inches and compact with an internal mechanical vibrator
   2. Do not spread concrete with vibrators.

L. Do not interrupt successive placement; do not permit cold joints to occur.

M. Place floor slabs in long strips as illustrated in ACI 302 where possible.

N. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.

O. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 ft. Slope to floor drains where applicable.

P. The maximum free drop of concrete, where reinforcing will cause segregation of mix, allowed:
   1. Superplasticized Concrete: 10 ft maximum drop
   2. Other concrete 5 ft maximum drop

Q. Pitch floor to floor drains with a minimum slope of 1/8 inch per foot or as shown on the Drawings.

R. Apply sealants to joints in accordance with Section 07900.

3.4 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required reinforcing and other items to be cast in.

C. Apply bonding agent to substrate in accordance with Manufacturer's instructions.

D. Place concrete floor toppings to required lines and levels.

E. Screed toppings level, maintaining surface flatness.

3.5 CONCRETE FINISHING

A. Finish concrete floor surfaces in accordance with Section 03346.

B. Rough Form Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water, wastewater or subsequent construction.
   1. Patch honeycombing, stone pockets, form ties, spalls and other irregularities as specified in this section and cure.
   2. Where joint marks or fins on submerged surfaces exceed ¼ inch, grind smooth

C. Smooth Form Finish: Interior concrete surfaces permanently exposed to view, interior surface of tanks exposed to view extending 6 inches below liquid level and concrete surfaces scheduled to be painted.
   1. After removal of forms, patch or point up defects as specified and cure
   2. Grind joint marks and fins smooth with adjacent surface. Remove oil stains and rinse surface.
   3. After grinding and cleaning, dampen concrete and paint entire surface with cement grout. Work cement grout into surface with cork or other suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with dry burlap or carpet.
   4. Prepare surfaces to be painted in accordance with Section 09900 and paint manufacturer's requirements.

D. Rubbed Form Finish: Exterior cast-in-place concrete surfaces permanently exposed to view extending to 6 inch below finish grade or liquid level, unless otherwise indicated on Drawings.
   1. After removal of forms, patch or point up defects as specified and cure.
   2. Remove joint marks, fins, and stains as described for smooth finish,
   3. Apply heavy coat of finishing grout. After the first coat has set, apply a second coat. When the second coat has set, float to uniform texture.
   4. Follow manufacturer's written instructions for finishing concrete.
   5. Finish color shall be gray.

E. Prepare surfaces which have other materials applied in accordance with requirements specified in other Sections.

3.6 CURING AND PROTECTION

A. Cure concrete surfaces in accordance with Section 03370.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.7 SCREED FINISH ON CLARIFIER SLABS

A. The purpose of the grout topping is to provide a smooth, even surface for the clarifier equipment operation. Place the grout topping on the floor of the clarifier tank after the equipment for the tank has been completely installed and works.

B. Remove all laitance from the surface of the concrete with a sand blast or water blast and thoroughly work and clean the surface. Keep the concrete base constantly wet for 24 hours, remove standing water and free moisture, and then hand sweep with a thick cement-water slurry mixture before placing the grout topping.

C. Mix proportions for the grout topping will be as specified in 2.3.E. Mix the grout in a concrete plant to a thick, creamy consistency so it can easily be screeded, but not so thin that it will not stand to the required thickness. Place grout in conformance with the clarifier equipment Manufacturer's instructions.

D. The grout in each clarifier will be placed without cold joints and will extend from the outside wall to the center of the basin. Use the clarifier equipment as a guide to accurately shape the grout. Do not use the mechanism to push or form the grout.

E. Keep the topping damp by using a hose with fine mist spray to prevent premature drying. When the grout topping is sufficiently hard, fill the tank with water to a level adequate enough to keep the entire floor covered. Keep floor submerged for seven days.

3.8 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections and repair defective areas in accordance with ACI 301. Use a non-shrink nonmetallic grout.

D. Obtain Engineer's approval of proposed repair techniques and mixes.

3.9 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Architect/Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

3.10 FIELD QUALITY CONTROL

A. Obtain samples of concrete in accordance with ASTM C172. Transport cylinders to an on-site location where they can be stored under conditions affecting concrete they represent without being disturbed for first 24 hrs.

B. Make slump tests daily and when requested by ENGINEER, in accordance with ASTM C143. Make slump tests from same batch from which strength tests are made.

C. When air-entrained concrete is used, make air content tests daily and when requested by ENGINEER in accordance with ASTM C231.

D. If measured slump or air content falls outside limits-specified, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.

E. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from single load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of specimens as determined in accordance with ASTM C39. If specimen in test shows manifest evidence of improper sampling, molding or testing, it will be disregarded. Test remaining cylinder if needed.

F. Make strength test for each following condition for each class of concrete.
   1. Each day's pour.
   2. Each change of source.
   3. Each 100 cu yds of concrete poured.
   4. When temperatures are below or are expected to fall below 45°F within 48 hrs after concrete is placed, make 2 additional cylinders and cure in field under conditions approximating the conditions affecting the concrete they represent. Test one at 7 days, the other at 28 days.

G. Strength level of individual class of concrete is considered satisfactory if the following requirements are met.
   1. Average of all sets of 3 consecutive strength tests equal or exceed the specified 28 day compressive strength.
   2. No individual strength test falls below the specified 28 day compressive strength by more than 500 psi

H. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to the mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by ENGINEER to determine the strength of the concrete in-place in the portion of the structure identified with the deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications,

ENGINEER will determine whether or not Work in-place is adequate for the intended use the location. If Work is determined inadequate, CONTRACTOR shall follow such remedial or replacement measures which ENGINEER may require. CONTRACTOR shall bear costs in connection with testing, engineering analysis, remedial work, and replacements required under terms of this paragraph.

END OF SECTION

SECTION 03346

CONCRETE FINISHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finishing slabs on grade, monolithic floor slabs and floor toppings.

B. Surface treatment with concrete hardeners, sealers, and slip resistant coatings.

1.2 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 117-06 – Specification for Tolerances for Concrete Construction and Materials

D. ASTM C309 - Liquid Membrane-Forming compounds for Curing Concrete modified to meet the lower moisture loss requirements of FS TT-C800a or CRD-C 30-77.

E. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

F. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on concrete hardeners and sealers, curing compounds, and slip resistant treatment.

1.4 MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.

B. Maintain one copy of each document on site.

C. Applicators: Skilled applicators specializing in concrete surface treatments with a minimum three years documented experience and approved and certified by material manufacturers.

1.6 SAMPLE REFERENCE PANELS

A. Provide sample panels of floor finishes under the provisions of Section 01400.

B. Construct sample panels under conditions similar to those which will exist during actual placing, minimum 2 feet long by 2 feet wide, with coatings applied.

C. Locate where directed by Owner.

D. When accepted, sample reference panels will demonstrate minimum standard for the Work. Panels may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01600.

B. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Temporary Lighting: Minimum 200 W light source placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.

B. Temporary Heat: Ambient temperature of 50 degrees F minimum.

C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.9 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Coordinate the work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 HARDENERS AND SEALERS

A. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Floor Sealer: ASTM C309-Type 1-D cure and seal type;
1. Kure-N-Seal by Sonneborn
2. Cure and Seal by Symons
3. Approved equal.

C. Clear Floor Hardeners: Magnesium fluorosilicate and zinc fluorosilicate blend liquid type.
   1. Flouhard by L&M Construction Chemicals, Inc.
   2. Lapidolith by Sonneborn
   3. Approved equal

D. Membrane Forming Curing Compounds: see Section 03370

2.2 SLIP RESISTANT TREATMENT

A. Slip Resistant Finish: Aluminum oxide type, color as selected from Manufacturer's standard range.

2.3 EPOXY FLOOR FINISH

A. See Division 9.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify that floor surfaces are acceptable to receive the Work of this Section.

3.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.

B. Wood float surfaces which will receive quarry tile, and ceramic tile with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set ceramic tile, thin set terrazzo and thin set quarry tile.

D. Steel trowel surfaces twice (two trowelings) which are scheduled to be exposed.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

3.3 FLOOR SURFACE TREATMENT

A. Apply slip resistant finish in accordance with manufacturer's instructions as scheduled on floor and stair surfaces.

B. Broom Finish: Float and immediately light broom finish with soft bristled push broom to for all exterior slabs. Trowel once and light broom finish interior stairs and ramps, and per the room finish schedule. Broom at right angles to direction of traffic.

C. Clear Floor Hardener: Apply according to manufacturer's written instructions where shown on the room finish schedule.

D. Floor Sealer:
   1. Apply in accordance with manufacturer's written instructions
   2. Apply first coat after final troweling, surface water glaze has dissipated, and when shown on the room finish schedule
   3. Clean floor and apply second coat after Work is complete and building is ready for occupancy.

3.4 TOLERANCES

A. Measure for FF (Floor Flatness) and FL (Floor Levelness) tolerances for floor in accordance with ASTM E1155, within 48 hours after slab installation.

B. Finish concrete to achieve the following tolerances:
   1. Under Quarry Tile on Setting Bed: FF 35 and FL 20.
   2. Under Resilient Finishes: FF 60 under FL 40.
   3. Exposed to View and Foot Traffic: FF 60 and FL 40.

C. Correct the slab surface if the actual FF or FL number for the floor installation measures less than required.

D. Correct defects in the defined traffic floor by grinding or removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

END OF SECTION

SECTION 03370

CONCRETE CURING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Initial and final curing of horizontal and vertical concrete surfaces.

1.2 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.

C. ACI 308 - Standard Practice for Curing Concrete.

D. ACI 350 – Environmental Engineering Concrete Structures.

E. ASTM C156 - Water Retention by Concrete Curing Materials.

F. ASTM C171 - Sheet Materials for Curing Concrete.

G. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete modified to meet the lower moisture loss requirements of FS TT-C800a or CRD-C300-77.

H. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

I. ASTM D2103 - Polyethylene Film and Sheeting.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on curing compounds, mats, paper, film, rate of coverage, compatibilities and limitations.

C. Certification: Curing compound manufacturer shall certify their product, stating the product's effectiveness for the proposed application.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 302, ACI 308 and ACI 350.

B. Maintain one copy of each document on site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products under provisions of Section 01600.

B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. All materials shall be classified as acceptable for potable water use according to NSF Standard 61.

B. Materials for curing concrete as indicated herein shall conform to the following requirements and ASTM C 309
   1. Interior Concrete: Type 1-D – Clear or transparent with fugitive dye, compatible with scheduled finishes and coatings.
   2. Exterior Concrete: Type 2 – White pigmented.

C. Membrane Forming Curing Compounds: Interior Use
   1. Kure and Seal 30 by BASF
   2. Kurez DR Vox by The Euclid Chemical Company
   3. Approved Equal

D. Membrane Forming Curing Compounds: Interior Use – Water based resin curing compounds shall be used only where local air quality regulations prohibit use of solvent based compounds.
   1. Aqua Cure by The Euclid Chemical Company
   2. Cure R by L&M Construction Chemicals, Inc.
   3. Approved Equal

E. Membrane Forming Curing Compounds: Exterior Use
   1. Cure R-2 by L&M Construction Chemicals, Inc.
   2. Kurez Vox White Pigmented by the Euclid Chemical Company
   3. Approved Equal

F. Absorptive Mats: ASTM C171, burlap-polyethylene, minimum 9 oz/sq yd bonded to prevent separation during handling and placing.

G. Polyethylene Film: ASTM C171, 6 mil thick, white; ASTM C156 loss of moisture less than 0.055 grams per square centimeter of surface.

H. Water: Potable and not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate conditions.

B. Verify that substrate surfaces are ready to be cured.

C. Do not use curing compound on surfaces that are to receive additional concrete, paint, or tile, etc. that requires a positive bond, unless it can be demonstrated that the membrane can be satisfactorily removed before the subsequent application, or that the membrane can serve as a base for the later application. Otherwise use water curing.

3.2 EXECUTION - HORIZONTAL SURFACES

A. Cure floor surfaces in accordance with ACI 308 using one of the following methods:
1. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 4 days.
2. Spraying: Spray water over floor slab areas and maintain wet for 7 days.
3. Absorptive Mat: Saturate burlap-polyethylene mat and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.
4. Membrane Curing Compound: Apply curing compound in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first. Do not use curing compound where sealer, epoxy, mortar bed, grout, additional concrete or other coatings will be applied.
5. Polyethylene Film: Spread over floor slab areas, lap edges and sides, seal with pressure sensitive tape; maintain in place for 7 days.

3.3 EXECUTION - VERTICAL SURFACES

A. Cure surfaces in accordance with ACI 308 using one of the following methods:
1. Spraying: Continuously spray water over surfaces and maintain wet for 7 days.
2. Membrane Curing Compound: Apply curing compound, immediately after removal of forms, in accordance with manufacturer's instructions in 2 coats with second coat at right angles to first.
3. Leave concrete forms in place and keep sufficiently damp at all times to prevent opening of the joints and drying of concrete.

3.4 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500.

B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 04065

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

B. General Requirements: Perform the work of this section in accordance with Division One of these specifications.

1.2 REFERENCES

A. American Society for Testing and Materials:
1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
2. ASTM C91 - Standard Specification for Masonry Cement.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
8. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
12. ASTM C476 - Standard Specification for Grout for Masonry.
13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.

1.3 SUBMITTALS

A. Samples: Submit two samples of mortar, illustrating mortar color and color range.

B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

C. Test Reports:
1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content and compressive strength.
2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

D. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Hot and Cold Weather Requirements: TMS MSJC Specification.

PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers:
1. Western Lime & Cement: Western Masons Mix Type S, or equal.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color.

B. Masonry Cement: ASTM C91, Type S.

C. Premix Mortar: ASTM C387, Type S. gray color, normal strength.

D. Mortar Aggregate: ASTM C144, standard masonry type.

E. Grout Aggregate: ASTM C404, fine and coarse.

F. Water: Clean and potable.

G. Mortar Color:
1. Mortar for split-face concrete block and/or face brick: color as selected. Colored mortar to be premixed.
2. All other mortar: uncolored.

H. Plasticizer: Water reducing type which reduces porosity and absorption to increase bond strength.

I. Water Repellent: Granular type; “Rohepel” by BASF, “Dry Block” by W.R. GRACE or approved equal.

J. Bonding Agent: Epoxy type.

2.3 MIXES

A. Mortar Mixes:
1. Mortar For Structural Masonry: ASTM C270, Type S using Property specification or to achieve 1800 psi strength.
2. Mortar For Non-Structural Masonry: ASTM C270, Type S using Property specification or to achieve 1800 psi strength.

3. Pointing Mortar: ASTM C270, Type N using Property specification.

B. Mortar Mixing:
1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
2. Achieve uniformly damp sand immediately before mixing process.
3. Add mortar color and admixtures to achieve uniformity of mix and coloration.
4. Re-temper only within two hours of mixing.

C. Grout Mixes:
1. Grout for Pilasters, Bond Beams and Lintels 3,000 psi strength at 28 days; 7-8 inches slump; mixed in accordance with ASTM C476 Coarse grout.

D. Grout Mixing:
1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
2. Add admixtures in accordance with Manufacturer's instructions; mix uniformly.
3. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTIONS

3.1 EXAMINATION

A. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug cleanout holes with masonry units to prevent leakage of grout materials. Brace masonry for wet grout pressure.

3.3 INSTALLATION

A. Install mortar and grout.

B. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.

C. Do not displace reinforcement while placing grout.

D. Remove excess mortar from grout spaces.

END OF SECTION

SECTION 04820

REINFORCED UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes face brick, concrete masonry units, cut limestone, reinforcement, anchorage, and accessories.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 530 - Building Code Requirements for Masonry Structures.
2. ACI 530.1 - Specifications for Masonry Structures.

B. American Society for Testing and Materials:
1. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
8. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
9. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
11. ASTM C55 - Standard Specification for Concrete Brick.
12. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
13. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
14. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
15. ASTM C90 - Standard Specification for Load bearing Concrete Masonry Units.
16. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
17. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.

18. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
19. ASTM C568 - Standard Specification for Limestone Dimension Stone.
20. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
21. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).

C. Indiana Limestone Institute of America
1. Indiana Limestone Institute – Indiana Limestone Institute Handbook.
2. Indiana Limestone Institute – Safety Factor Technote.
3. Indiana Limestone Institute – Specifications for cut limestone.

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Product Data:
1. Submit data for concrete masonry units; face brick units and limestone units, fabricated wire reinforcement, wall ties, anchors and other accessories.
2. Indicate initial rate of absorption for clay and shale brick.

C. Samples: Submit four samples of face brick units and limestone units to illustrate color, texture and extremes of color range.

D. Shop Drawings: Indicate bars sizes, spacing, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, and accessories.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Maintain one copy of each document on site.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.

B. For performance based design for Indiana Limestone, comply with ILI Specifications for Indiana Limestone – Performance Specifications and ILI Safety Factor Technote.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01300 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Accept units on site. Inspect for damage.

C. Protect concrete masonry units from wetting while stored at the job site.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F and in accordance with the following:

1. Temperature of masonry units shall not be less than 32 degrees F when laid in masonry. Remove visible ice on masonry units before unit is laid in masonry.
2. Heat mortar sand and/or mixing water to produce mortar temperatures between 50 and 120 degrees F at time of mixing. Maintain mortar above freezing until used in masonry.
3. When ambient temperatures are between 20 and 32 degrees F, use heat sources on both sides of masonry under construction and install wind breaks when wind velocity is in excess of 15 mph.
4. When ambient temperatures are below 20 degrees F, provide enclosure for masonry under construction and use heat sources to maintain temperatures above 32 degrees F within enclosure.
5. When mean daily temperatures are between 32 and 40 degrees F, protect completed masonry from rain or snow by covering with weather resistant membrane for 24 hours after construction.
6. When mean daily temperatures are between 25 and 32 degrees F, protect completed masonry by completely covering it with insulating blankets or equal protection for 24 hours.
7. Where mean daily temperatures are below 25 degrees F, maintain masonry temperatures above 32 degrees F for 24 hours after construction by enclosure with supplementary heat, electric blankets, infrared heat lamps or other acceptable methods.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph and in accordance with the following:

1. Do not spread mortar beds more than 4 ft ahead of masonry.
2. Set masonry units within 1 minute of spreading mortar.

1.9 COORDINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Coordinate masonry work with veneer and installation of window, door, louver and other openings in wall surface.

1.10 EXTRA MATERIALS

A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

B. Supply 50 of each size, color, and type of face brick units.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Face Brick: ASTM C216, Type FBS, Grade SW;
   1. Manufacturer: Glen-Gery Corporation
   2. Color: Aberdeen
   3. Local supplier: County Materials Corporation

B. Brick Size and Shape: Modular: 3-5/8” x 2-1/4” x 7-5/8”

C. Hollow Load Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

D. Solid Load-Bearing Concrete Masonry Units (CMU): ASTM C90; normal weight.

E. Concrete Brick Units: ASTM C55; normal weight.

F. Concrete Masonry Unit Size and Shape: Nominal modular size of 8” x 8” x 16” inches. Furnish special units for 90 degree corners, bond beams, lintels coved base and bullnosed corners for vertical corners including door and window openings.

G. Limestone:
   1. Limestone: Indiana Oolitic Limestone; complying with ASTM C568 Classification II – Medium Density.
   2. Grade: ILI Select.
   3. Color: By owner.
   4. Grain Direction: Horizontal.
   5. Fabrication Tolerances: In accordance with Indiana Limestone Handbook and with details shown on Drawings.
   6. Surface Texture: ILI Smooth.
   7. Acceptable Quarries: Indiana Oolitic Limestone as quarried in Lawrence, Monroe, and Owen Counties, Indiana.

H. Sprayed on Air & Water Resistive Barrier: “Prosoco” R-Guard Spray Wrap. Fluid applied Flexible Acrylic Coating. ASTM E-2178 Air Barrier & ASTM E-96 >5 Perms

I. Masonry Core Insulation: Perlite loose-fill insulation. Each package shall be clearly marked such. The insulation material shall conform to the requirements of ASTM C549.

2.2 ACCESSORIES

A. Single Wythe Joint Reinforcement: ASTM A951; truss type; steel 0.188 inch diameter side rods with 0.188 inch diameter cross ties; hot dip galvanized. Provide special corner and wall intersection pieces.

B. Multiple Wythe Joint Reinforcement: ASTM A951/A951M; truss type; steel; without moisture drip; adjustable type; 0.188 diameter side rods with 0.148 inch diameter cross ties; hot dip galvanized.

C. Reinforcing Steel: as specified in Section 03200.

D. Strap Anchors: bent steel shape, 1 ¾" x "length indicated or required" inch size x 1/8 inch thick, hot dip galvanized to ASTM A153/A153M B2 finish.

E. Wall Ties: Formed steel wire, 3/16 inch thick, adjustable, hot dip galvanized to ASTM A153/A153M B2 finish.

F. Dovetail Anchors: Bent steel strap, 1 x "length indicated or required" inch size x 12 gage thick, galvanized to ASTM A153/A153M B2 finish.

G. Anchor Rods: Headed, galvanized; J-shaped or L-shaped; minimum ½ inch diameter; spaced at not more than 48 inches on center; complete with washers and heavy hex nuts; anchors must be welded or hooked to not less than 0.20 square inches of bond beam reinforcement; sized for minimum 6 inch embedment. If anchors are not welded or hooked to reinforcement, anchors shall be embedded 15 inches into masonry.
   1. Hot-Dipped Galvanizing: ASTM A153/A153M.

H. Mortar and Grout: As specified in Section 04065.

I. Stainless Steel: ASTM A666, Type 304, soft temper; 0.010 inch thick; smooth finish.

J. Lap Sealant: Butyl type as specified in Section 07900.

K. Preformed Control Joints: Rubber material. Furnish with corner and tee accessories, heat fused joints. Use DuraWall D/A 2001 by DuraWall; Greenstreak Model 571 by Greenstreak; or approved equal.

L. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding; 3 inch wide x by maximum lengths.

M. Building Paper: ASTM D226, No. 15 asphalt saturated felt.

N. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

O. Cavity Ventilation and Drainage
   1. Weep Vents:
      a. Preformed UV-resistant plastic mesh (designed to fill head joint with outside face held back to match mortar in adjacent joints) allowing free

flow of moisture and air. Select from manufacturer's standard colors to match adjacent mortar.

b. Products: "Mortar Net Weep Vents" by Mortar Net, "Cell Vent" by Dur-O-Wall or equal.

2. Embedded Flashing:

a. Minimum 40 mil flexible membrane.

b. Products: "Air-Shield" by W.R. Meadows, "Perm-A-Barrier" by Grace Construction Products, or equal.

3. Cavity Net:

a. Preformed plastic mesh (designed to catch mortar droppings without clogging) allowing free flow of moisture and air.

b. Products: "Mortar Net" by Mortar Net, "Mortar Stop" by Polytite, or equal.

P. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials. As recommended by face brick Manufacturer.

Q. Precast Concrete Lintels: type and, size, as indicated on drawings, 5000 psi strength at 28 days.

R. Reinforced unit masonry blocks filled with concrete and reinforced with steel as detailed.

S. Steel Lintels: size as indicated on Drawings; as specified in Section 05500

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

D. Coursing of Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches.
   3. Mortar Joints: Concave.

E. Placing And Bonding:
   1. Lay solid masonry units in full bed of mortar, with full head joints.
   2. Lay hollow masonry units with face shell bedding on head and bed joints.
   3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
   4. Remove excess mortar as Work progresses.
   5. Interlock intersections and external corners.
   6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
   7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
   8. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, or bitumen dampproofing is applied.
   9. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings.
   10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

F. Weeps and Vents: Furnish weeps and vents in outer wythe at 24 inches oc horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

G. Cavity Wall: Do not permit mortar to drop or accumulated into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier adhesive.

H. Joint Reinforcement and Anchorage – Single Wythe Masonry:
   1. Install horizontal joint reinforcement 16 inches oc.
   2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
   3. Place joint reinforcement continuous in first and second joint below top of walls.
   4. Lap joint reinforcement ends minimum 6 inches.
   5. Support and secure reinforcing bars from displacement.
   6. Embed anchors embedded in concrete and attached to structural steel members. Embed anchorages in every second block joint.
   7. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches oc.

I. Joint Reinforcement And Anchorage - Masonry Veneer:
   1. Install horizontal joint reinforcement 16 inches oc.

2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Embed wall ties in masonry backing to bond veneer at maximum inches 16 inches oc vertically and 16 inches oc horizontally. Place wall ties at maximum 8 inches oc vertically within 8 inches of jamb of wall openings.

J. Joint Reinforcement And Anchorages – Multiple Wythe Cavity Wall Masonry:
1. Install horizontal joint reinforcement 16 inches oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
3. Place joint reinforcement continuous in first and second joint below top of walls.
4. Lap joint reinforcement ends minimum 6 inches.
5. Reinforce stack bonded unit joint corners and intersections with strap anchors at 16 inches oc.

K. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, under parapet caps, at bottom of walls, and turn down on outside face to form drip.
2. Turn flashing up minimum 8 inches and bed into mortar joint of masonry, seal to concrete or seal to sheathing over framed backing.
3. Lap end joints minimum 6 inches and seal watertight.
4. Turn flashing, fold, and seal at corners, bends, and interruptions.

L. Lintels:
1. Install loose steel lintels over openings.
2. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
3. Openings Up To 36 inches wide: Place two, No. 5 reinforcing bars 1 inch from bottom web.
4. Do not splice reinforcing bars.
5. Support and secure reinforcing bars from displacement.
6. Place and consolidate grout fill without displacing reinforcing.
7. Allow masonry lintels to attain specified strength before removing temporary supports.
8. Maintain minimum 8 inch bearing on each side of opening.

M. Grouted Components:
1. Reinforce bond beam with steel bars, 1 inch from bottom web see plans.
2. Lap splices as required by code.
3. Support and secure reinforcing bars from displacement.
4. Place and consolidate grout fill without displacing reinforcing.
5. At bearing locations, fill masonry cores with grout for minimum 16 inches either side of opening.

N. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.

2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03200.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with ACI 530.1 Specification for Masonry Structures.

O. Control and Expansion Joints:
1. Do not continue horizontal joint reinforcement through control and expansion joints.
2. Form control joint with sheet building paper bond breaker fitted to one side of hollow contour end of block unit. Fill resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant or install preformed control joint device in continuous lengths. Seal butt and corner joints.
3. Do not use preformed control joint devices at control joints above or below openings.
4. Size control joint in accordance with Section 07900 for sealant performance.
5. Form expansion joint by omitting mortar and cutting unit to form open space. Placed as indicated on Drawings.

P. Built-In Work:
1. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.

Q. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements, 01700 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Brick Units: Test each type in accordance with ASTM C67, 5 random units for each 50,000 units installed.

C. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

A. Section 01700 - Execution Requirements: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.7 PROTECTION OF WORK

A. Section 01700 - Execution Requirements: Requirements for protecting finished Work.

B. Protect exposed external corners subject to damage.

C. Protect base of walls from mud and mortar splatter.

D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop fabricated metal items.

1.2 REFERENCES

A. Aluminum Association:
1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Society of Mechanical Engineers (ASME)
1. ASME Boiler and Pressure Vessel Code Section IX

C. American Society for Testing and Materials:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
6. ASTM A283/283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
7. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. ASTM A992/A992M - Standard Specification for Structural Steel Shapes
11. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
12. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
13. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
14. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
15. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
16. ASTM F436 - Standard Specification for Hardened Steel Washers.
17. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.6 - Structural Welding Code - Stainless Steel.

E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 10 - Near-White Blast Cleaning.
4. SSPC Paint 15 - Steel Joist Shop Paint.
5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, finishes, size and type of fasteners, and accessories. Provide pressure calculations of access hatches. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

C. Manufacturer's Installation Instructions: Indicate installation requirements, and rough-in dimensions.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALIFICATIONS

A. Design under direct supervision of Professional Engineer experienced in design of this Work and licensed in State in which the Work is located.

B. If requested by Engineer or required on Drawings, submit calculations sealed by a Professional Engineer licensed in the State in which the Work is located.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.6 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Structural W-Shapes: ASTM A992/A992M.

B. Channels and Angles: ASTM A36/A36M

C. Hollow Structural Sections: ASTM A500/A500M, Grade B

D. Plates: ASTM A283/A283M.

E. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40.

F. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality, galvanized.

G. Bolts ASTM A325; Type 1.
1. Finish Hot dipped galvanized to ASTM A153/A153M

H. Nuts: ASTM A563 heavy hex type.
1. Finish Hot dipped galvanized to ASTM A153/A153M

I. Washers: ASTM F436; Type 1.
1. Finish Hot dipped galvanized to ASTM A153/A153M

J. Welding Materials: AWS D1.1; type required for materials being welded.

K. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

L. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic.

2.2 MATERIALS – STAINLESS STEEL

A. Exterior and submerged uses: Type 316

B. Industrial uses: Type 316

C. Interior and architectural uses: Type 304 unless otherwise noted

D. Cast-in-place anchor bolts: Type 316, unless otherwise noted

E. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

A. Structural Shapes and Plates: Alloy 6061, Temper T6. As required by ASTM sections referenced in the Aluminum Association's current Construction Manual.

B. Bolts, Nuts, and Washers: Type 316 Stainless steel.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ANCHOR BOLTS

A. Anchor Bolts for Equipment and Machinery, where permanently anchored into concrete: Stainless steel, unless otherwise shown. The diameter, length, and any bend dimensions shall be as required by the equipment or machinery manufacturer. Unless otherwise required, use 3/4-inch minimum diameter and other geometry shown on the Drawings. Furnish a minimum of two nuts and a washer of the same material for each bolt. Provide sleeves as required or as shown for location adjustment.

B. Anchor Bolts for Other Uses to anchor fabricated metalwork or structural building columns, or other components where the connection will be protected or dry: Galvanized ASTM A307; Grade A, steel. Minimum size shall be 3/4-inch diameter by 12-inch long, unless otherwise shown. Furnish two nuts and one washer per bolt of the same material as the bolt, unless otherwise shown.

C. Anchor Bolts for Other Uses to anchor fabricated metalwork or structural building, or structural frame components in areas of wet use, wash down areas, or areas outside heated buildings: Stainless steel. Minimum size shall be 3/4-inch diameter by 12-inch long, unless otherwise shown. Furnish two nuts and one washer per bolt of the same material as the bolt, unless otherwise shown.

D. Where stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners are used, Contractor shall apply an anti-seizing lubricant to the threads before making up the connections. The lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc or copper.

2.5 CONCRETE ANCHORS

A. Expansion Anchors:
   1. Product/Manufacturers
      a. Kwik Bolt 3 Expansion Anchor by Hilti
      b. Kwik Bolt TZ Expansion Anchor by Hilti
      c. HSL-3 Heavy Duty Expansion Anchor by Hilti
      d. Power-Bolt by Powers Fasteners
      e. Power-Stud by Powers Fasteners
      f. Or approved equal
   2. Usage: In concrete – dry - above 1’-6” the peak (maximum) water surface in any water/liquid containing structure.
      a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
      b. Zinc or chromate-plated carbon steel may be used in interior locations with controlled humidity, and other protected locations unless otherwise noted.
      c. Do not use expansion anchors when submerged, subject to dynamic loads or in overhead applications.

B. Adhesive Anchors:

1. Product/Manufacturers
    a. HIT-RE 500-SD by Hilti
    b. HIT HY 150 MAX by Hilti
    c. HIT ICE/HIT HY 150 Adhesive by Hilti
    d. AC100+Gold by Powers Fasteners
    e. PE+ by Powers Fasteners
    f. Or approved equal
2. Usage: In concrete – submerged – below 1’-6” the peak (maximum) water surface in any water/liquid containing structure.
    a. Stainless steel, Type 316,
    b. Do not use when subject to dynamic loads and overhead applications.

C. Undercut Anchors:
1. Product/Manufacturers
    a. Maxi-Bolt undercut anchor system by Drillco Devices, Ltd.
    b. HDA Undercut Anchor by Hilti
    c. Or approved equal
2. Usage: In concrete – overhead applications, and for dynamic loads
    a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
    b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
    c. Do not use undercut anchors when submerged.

D. Screw Anchors:
1. Product/Manufacturers
    a. HUS-H Concrete Screw Anchot by Hilti
    b. Kwik Con II Screw Anchor by Hilti (for non-structural applications)
    c. Wedge-Bolt by Powers Fasteners
    d. Tapper by Powers Fasteners (for non-structural applications)
    e. Or approved equal
2. Usage: In concrete – dry - above 1’-6” the peak (maximum) water surface in any water/liquid containing structure.
    a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
    b. Zinc or chromate-plated carbon steel may be used in interior locations with controlled humidity, and other protected locations unless otherwise noted.
    c. Do not use screw anchors when submerged, subject to dynamic loads or in overhead applications.

E. Tie-Wire Anchors: Type 316 stainless steel, Powers SPIKE or approved equal.

2.6 MASONRY ANCHORS

A. Hollow Core Concrete Block
1. Product/Manufacturers
    a. HIT HY 20 Adhesive by Hilti
    b. HIT HY 150 MAX by Hilti

c. AC100+Gold by Powers Fasteners
d. PE+ by Powers Fasteners
e. Or approved equal

2. Usage: In hollow core concrete block
   a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
   b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
   c. Install per manufacturers recommendation.

B. Grout Filled Concrete Block
1. Product/Manufacturers
   a. AC100+Gold by Powers Fasteners
   b. PE+ by Powers Fasteners
   c. HIT HY 150 MAX by Hilti
   d. HIT ICE/HIT HY 150 Adhesive by Hilti
   e. Kwik Con II Screw Anchor by Hilti (for non-structural applications)
   f. Tapper by Powers Fasteners (for non-structural applications)
   g. Or approved equal
2. Usage: In grout filled concrete block
   a. Stainless steel, Type 316, shall be used in locations such outside, in tanks, or when attaching aluminum or galvanized steel.
   b. Zinc or chromate-plated carbon steel may be used where totally embedded, in interior locations with controlled humidity, and other protected locations unless otherwise noted.
   c. Install per manufacturers recommendation.

2.7 COMPONENTS

A. Following is list of principal items only. Refer to Drawings for items not specifically scheduled.

B. Lintels: As detailed on Drawings; prime paint finish.

2.8 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.9 FACTORY APPLIED FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime paint items in accordance with Section 09900.

D. Galvanized Structural Steel Members: Galvanize after fabrication to ASTM A123. Furnish minimum 1.25 oz/sq ft galvanized coating.

E. Galvanized Non-structural Items: Galvanized after fabrication to ASTM A123. Furnish minimum 1.25 oz/sq ft galvanized coating.

2.10 FACTORY APPLIED FINISHES - ALUMINUM

A. Exposed Aluminum Surfaces: Mill finish.

B. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.11 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.

B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

C. Field weld components indicated on Drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

G. Install in accordance with Drawings, shop drawings and manufacturer's instructions.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.

B. Maximum Offset from Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rough carpentry, roof sheathing, blocking in walls and roof openings, curbs, miscellaneous framing and sheathing, and wood treatment.

1.2 REFERENCES

A. MIL-L-1914-C Lumber and Plywood, Fire Retardant Treated.

B. MIL-V-13518C(1) Wood Preservative: Tetrachlorophenol and Pentachlorophenol, Surface Sealing Compound.

C. PS 1 - Construction and Industrial Plywood.

D. PS 20 - American Softwood Lumber Standard.

E. PS 51 - Hardwood and Decorative Plywood.

F. PS 58 - Basic Hardwood.

G. NFPA - National Design Specification for Wood Construction.

H. APA - American Plywood Association.

I. AWPA - American Wood Preservers' Association. U1 - Use Category System: User Specification for Treated Wood.

1.3 QUALITY ASSURANCE

A. Rough Carpentry Lumber: Visible grade stamp, of agency certified by National Forest Products Association (NFPA).

B. Plywood Grading Agency: Certified by APA.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 01330.

B. Submit product data under provisions of Section 01330.

C. Provide technical data on wood preservative materials and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver shop fabricated carpentry items until site conditions are adequate to receive the work. Protect items from weather while in transit.

B. Store indoors, in ventilated areas with a constant, minimum temperature of 60 degrees F (16 degrees C), maximum relative humidity of 25 to 55 percent.

PART 2 PRODUCTS

2.1 ROUGH CARPENTRY MATERIALS

A. Lumber: PS 20; graded in accordance with established Grading rules; maximum moisture content of 19 percent; of following species and grades:
   1. Structural Light Framing: Stress Group A; select structural; No. 1 grade.
   2. Non-structural Light Framing: Stress Group A; construction, grade.
   3. Studding: Stress Group A; stud grade.
   4. Structural Joists and Planks: Stress Group A; No. 1 grade.

B. Douglas Fir Plywood: Sheathing, grade.

C. Poplar Plywood: Solid sheathing grade; exterior waterproof type.

D. Wood Particleboard: Composed of wood chips type made with high waterproof resin binders of grade to suit application; sanded faces.

E. Pressure Treated Southern Pine:
   1. Select structural or No. 1SR grade.
   2. Wood Preservative (Pressure Treatment): micronized copper quat (MCQ), 0.40 lbs. per cu.ft.
   3. AWPA Standards U1
   4. Treat all cut ends.

F. Nails, Spikes and Staples: Galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations; size and type to suit application.

G. Bolts, Nuts, Washers, Lags, Pins and Screws: Medium carbon steel; sized to suit application galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations.

H. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolts or power activated type for anchorage to steel.

I. Screws: Bugle head, steel, power driven type length of three times thickness of sheathing. Screw shall be corrosion-resistant. Use Type S-12 screws when attaching to heavy steel gauge (12 to 22 gauge) and Type S screw for light gauge framing. Use Type W screws for wood framing.

J. Building Paper: No. 15 asphalt felt.

2.2 WOOD TREATMENT

A. Fire Retardant: Chemically treated and pressure impregnated.
   1. AWPB LP-3, aboveground application, light petroleum solvent.
   2. AWPB LP-33 ground contact application, light petroleum solvent.

B. Provide preservative treated wood for all framing, blocking, furring, nailing strips built into exterior masonry walls, wood in contact with concrete and in conjunction with gravel stops, and roofing.

C. Redry and clean lumber, after treatment, to maximum moisture content of 19 percent, stamped DRY.

D. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

PART 3 EXECUTION

3.1 FRAMING, FURRING, AND STRIPPING

A. Erect wood framing, furring, stripping and nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch.

B. Place horizontal members laid flat, crown side-up.

C. Construct members of continuous pieces of longest possible lengths.

D. Space members at 16 o.c. unless indicated otherwise.

E. Double members at openings over one square foot. Space short studs over and under opening to stud spacing.

F. Construct double joist headers at floor and ceiling openings. Frame rigidly into joists.

G. Bridge joists in excess of eight feet span at mid-span members. Fit solid blocking at end of members.

H. Lay out, cut, fit, and install all rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.

I. Install items accurate to dimension, true to line, level, and square. Provide for installation and support of other work.

J. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

K. Install all wood in conjunction with roofing using screw attachment to metal decking and steel framing. Bolt wood blocking to masonry where indicated.

END OF SECTION

SECTION 06173

WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes shop fabricated wood trusses for roof framing; bridging, bracing, and anchorage; and preservative treatment of wood.

1.2 REFERENCES

A. ALSC (American Lumber Standards Committee) - Softwood Lumber Standards.

B. ANSI A208.1 - Mat-Formed Wood Particleboard.

C. APA (APA/Engineered Wood Association) - Plywood Grading Rules.

D. APA/EWA TB-200 (APA/Engineered Wood Association) - Technical Bulletin (Fire Retardant).

E. ASTM A167 - Stainless and Heat Resisting Chromium - Nickel Steel Plate, Sheet, and Strip.

F. ASTM A653/A653M - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

G. AWPA C1 (American Wood Preservers Association) - All Timber Products Preservative Treatment by Pressure Process.

H. AWPA C20 (American Wood Preservers Association) -Structural Lumber Fire Retardant Treatment by Pressure Process.

I. NFPA (National Forest Products Association) - Lumber Grading Rules.

J. SPIB (Southern Pine Inspection Bureau) - Lumber Grading Rules.

K. TPI DSB-89 (Truss Plate Institute) - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.

L. TPI HIB-91 (Truss Plate Institute) - Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses.

M. ANSI/TPI 1 - (Truss Plate Institute) National Design Standard for Metal Plate Connected Parallel Chord Wood Trusses.

N. WCLIB (West Coast Lumber Inspection Bureau) - Lumber Grading Rules.

O. WWPA (Western Wood Products Association) - Lumber Grading Rules.

1.3 SYSTEM DESCRIPTION

A. Design Roof Live Load: 30 lbs/sq ft with deflection limited to 1/240 of span including dead loads, ceiling load, and snow drift load.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate sizes and spacing of trusses and associated components, web and chord sizes, plate sizes, fastener descriptions and spacings, loads and truss cambers, framed openings. Submit design calculations, sealed and signed by engineer.

C. Product Data: Submit truss configurations, bearing and anchor details, bridging and bracing.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA/EWA.

B. Truss Design, Fabrication, and Installation: In accordance with ANSI/TPI 1 and TPI HIB-91.

1.6 QUALIFICATIONS

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

B. Design trusses under direct supervision of a professional engineer experienced in design of this Work and licensed in the state where the Project is located.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Product storage and handling requirements.

B. Handle and erect trusses in accordance with TPI HIB-91.

C. Store truss depth in vertical position resting on intermittent bearing pads.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Alpine Engineered Products, Inc.

2. Standard Structures, Inc.
3. Warren Truss Co.
4. Substitutions: Section 01600 - Product Requirements.

2.2 MATERIALS

A. Lumber Grading Rules: NFPA. SPIB. WCLIB. WWPA.

B. Steel Plate Connectors: ANSI/TPI 1, Section 6; hot dip galvanized; die stamped with integral teeth.

C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.3 ACCESSORIES

A. Wood Blocking, Support Members, Framing for Openings: In accordance with Section 06114 softwood lumber, construction grade, 19 percent maximum and 7 percent minimum moisture content.

B. Fasteners and Anchors:
1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

C. Bearing Plates: Hot dip galvanized.

2.4 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses for support in accordance with TPI HIB-91.

C. Provide top chord extensions as indicated.

D. Fabricate to achieve minimum end bearing of:
1. 1-1/2 inches on wood or steel.
2. 3 inches on masonry.

E. Frame special sized openings in web framing as detailed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of support items.

3.3 ERECTION

A. Set members level and plumb, in correct position.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of Architect/Engineer.

D. Place headers and supports to frame openings.

E. Frame openings between trusses with lumber in accordance with Section 06100.

F. Coordinate placement of sheathing with work of this Section.

G. After erection, touch-up damaged surfaces with primer consistent with shop coat.

3.4 SITE APPLIED WOOD TREATMENT

A. Brush apply one coats of preservative treatment on wood in contact with cementitious materials roofing and related metal flashings. Treat site-sawn cuts.

B. Allow preservative to dry prior to erecting members.

3.5 ERECTION TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes rigid board insulation at perimeter foundation wall, underside of floor slabs, and exterior cavity walls.

1.2 REFERENCES

A. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

B. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

C. ASTM E96 - Test Methods for Water Vapor Transmission of Materials.

1.3 PERFORMANCE REQUIREMENTS

A. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements in conjunction with vapor barrier materials in Section 03300.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data on product characteristics, performance criteria, and limitations.

C. Manufacturer's Installation Instructions: Indicate special environmental conditions required for installation, installation techniques.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.6 COORDINATION

A. Coordinate the Work with Section 03300 for installation of vapor barrier below concrete slabs.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

A. Dow Chemical Company, "Styrofoam SM".

B. Owens Corning, "Foamular".

C. Approved Equal.

2.2 INSULATION MATERIALS

A. Polystyrene Insulation: ASTM C578 Type IV; extruded cellular type, conforming to the following:

Thermal Resistance	R of 5.0 per inch Thickness when at 75 degrees F mean temperature
Thickness	Shall be 2 inches unless otherwise indicated on drawings
Board Size	16 x 96 inches at masonry cavity walls 24 x 96 inches at other areas
Compressive Strength	Minimum 25 psi
Water Absorption	In accordance with ASTM D2842, 0.3 percent by volume maximum
Edges	Square edges

2.3 ADHESIVES

A. Adhesive: Type recommended by insulation manufacturer for application. Compatible with insulation and substrate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation.

B. Verify substrate surface is flat, free of honeycomb fins and irregularities and materials or substances that may impede adhesive bond.

3.2 INSTALLATION - FOUNDATION PERIMETER

A. Adhere boards to all foundation wall perimeters, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.

B. Extend boards over control joints, unbonded to foundation 6 inches on one side of joint.

3.3 INSTALLATION - UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Prevent insulation from being displaced or damaged while placing vapor barrier and placing slab.

3.4 PROTECTION OF FINISHED WORK

A. Do not permit Work to be damaged prior to covering insulation.

END OF SECTION

SECTION 07213

BATT AND BLANKET INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Batt insulation for ceiling and roof construction.
2. Batt insulation for filling perimeter window, door shim spaces and crevices in exterior wall and roof.
3. Vapor Retarder for ceiling and walls

B. General Requirements: Perform work of this Section in accordance with Division One of these specifications.

1.2 REFERENCES

A. ASTM C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

B. FS HH-I-521 - Insulation Blankets, Thermal, (Mineral Fiber for Ambient Temperatures).

C. FS HH-I-558 - Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type).

1.3 PERFORMANCE REQUIREMENTS

A. Materials of this Section shall provide continuity of thermal barrier at building enclosure elements.

B. Materials of this Section shall provide continuity of vapor and air barrier at building enclosure elements.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS - INSULATION MATERIALS

A. Johns Manville.

B. Certain Teed.

C. Owens-Corning Corp.

D. Substitutions: Under provisions of Section 01600.

2.2 MATERIALS

A. Batt Insulation: ASTM C665, Type I without membrane; and Type III, Class A with a flame spread/smoke developed rating of 25/50; preformed glass fiber batt, friction fit. Thermal resistance value as shown on drawings.

B. Vapor Barrier: Polyethylene film for above grade application, 6 mil thick.

C. Tape: Polyethylene self-adhering type, 2 inches wide.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

A. Install insulation in accordance with insulation manufacturer's instructions.

B. Install in exterior walls without gaps or voids.

C. Trim insulation neatly to fit spaces.

D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.

E. Install with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Staple or nail in place at maximum 6 inches oc.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

H. At Metal Framing: Where indicated, place vapor barrier on warm side of insulation; lap and seal sheet barrier joints over member face. Tape all laps and penetrations.

I. Extend vapor barrier tight to full perimeter of adjacent window and door frames and other items interrupting the plane of membrane. Tape and seal in place.

END OF SECTION

SECTION 07270

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Fireproof firestopping, firesafing materials and accessories.

1.2 REFERENCES

A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E119 - Method for Fire Tests of Building Construction and Materials.

C. ASTM E814 - Test Method of Fire Tests of Through-Penetration Firestops.

1.3 PERFORMANCE REQUIREMENTS

A. Fireproofing Materials: UL 1479 and ASTM E814 to achieve a fire rating as noted on Drawings.

B. Surface Burning: ASTM E84 with a flame spread/fuel contributed/smoke developed rating of 0/0/0.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance and limitation criteria.

B. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in performing the work of this Section with minimum three years experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.8 SEQUENCING

A. Sequence Work to permit firestopping materials to be installed after adjacent and surrounding work is complete.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Intumescent Sheet: 3M Brand CS-195, or equal.

B. Wrap Strip: 3M Brand FS-195, or equal.

C. Sealant: 3M Brand FD 150+, or equal.

D. Putty: 3M Brand Putty 303.

E. Substitutions: Under provisions of Section 01600.

2.2 MATERIALS

A. Use products of the 3M Fire Protection Products, St. Paul, Minnesota, or equal. All materials shall be capable of maintaining an effective barrier against flame, smoke, and gases in compliance with the requirements of ASTM E 814 and UL 1479.

B. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.

2.3 ACCESSORIES

A. Dam Material: Mineral fiberboard.

2.4 FINISHES

A. Color: Dark gray.

2.5 MINERAL FIREPROOFING

A. Mineral Fireproofing: Noncombustible, 4 pounds per cubic foot density, mineral fiber conforming to Federal Specification HH-I-558.

B. Retainers: Weld-on clips, to support mineral fiber, with clinch shields.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings are ready to receive the Work of this Section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that may affect bond of firestopping material.

B. Remove incompatible materials that affect bond.

C. Install backing materials to arrest liquid material leakage.

3.3 APPLICATION

A. Apply primer and materials in accordance with manufacturer's instructions.

B. Apply firestopping material in sufficient thickness to achieve uniform density and texture.

C. Install material at walls or partition openings that contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.

D. Dam material to remain after firestopping material has cured.

3.4 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07311

ASPHALT SHINGLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes granular surfaced asphalt shingle roofing, moisture shedding underlayment, eave, and valley protection.

B. Provide associated metal flashings, counterflashing for roof mounted equipment and vent stacks, and accessories.

1.2 REFERENCES

A. ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process.

B. ASTM B209/B209M - Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

D. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

E. ASTM D2178 - Asphalt Glass (Felt) Used in Roofing and Waterproofing.

F. ASTM D2822 - Asphalt Roof Cement.

G. ASTM D3018 - Class A Asphalt Shingles Surfaced with Mineral Granules.

H. ASTM D3161 - Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method).

I. ASTM D3462 - Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules.

J. ASTM D4586 - Asphalt Roof Cement, Asbestos Free.

K. NRCA (National Roofing Contractors Association) - Steep Roofing Manual.

L. UL 55B (Underwriters Laboratories, Inc.) - Class C Asphalt Organic-Felt Sheet Roofing and Shingles.

M. UL 580 (Underwriters Laboratories, Inc.) - Tests for Wind Uplift Resistance of Roof Assemblies.

N. UL 790 (Underwriters Laboratories, Inc.) - Tests for Fire Resistance of Roof Covering Materials.

O. UL 997 (Underwriters Laboratories, Inc.) - Wind Resistance of Shingles.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for ASTM D3018 Class A for shingle types specified.

1.4 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate specially configured metal flashings, jointing methods and locations, fastening methods and locations, and installation details.

C. Product Data: Submit data indicating material characteristics, performance criteria, and limitations.

D. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern; for color and texture selection.

E. Manufacturer's Installation Instructions: Submit installation criteria and procedures.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NRCA Steep Roofing Manual.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01600 - Product Requirements.

B. Do not install eave protection and shingles when surface, ambient air, or wind chill temperatures are below 45 degrees F.

1.7 WARRANTY

A. Section 01700 - Execution Requirements: Product warranties and product bonds.

B. Provide 30 year full system warranty to include coverage of materials including shingles and accessories, installation, and damage resulting from failure to prevent penetration of water.

1.8 EXTRA MATERIALS

A. Section 01700 - Execution Requirements: Spare parts and maintenance products.

B. Supply 2% of full size units of each type/color/texture of shingle installed.

PART 2 PRODUCTS

2.1 ASPHALT SHINGLES

A. Manufacturers:
1. CertainTeed Corporation.
2. GAF Building Materials Corporation.
3. Owens Corning Corp.
4. Substitutions: Section 01600 - Product Requirements.

B. Product Description: Glass fiber mat base, ceramically colored/UV resistant mineral surface granules across entire face of shingle; two-piece laminated shingle ("dimensional"), minimum 240lb/100sf, ASTM D 3161/UL997 70-mph Wind Resistance, and UL Class A Fire Resistance. Color as selected by Owner from full line of manufacturers colors.

2.2 COMPONENTS

A. Underlayment and Eave Protection: ASTM D1970, Self-Adhering Polymer Modified Bituminous Sheet Material, 58 mil total thickness minimum, with strippable treated release paper; Winterguard as manufactured by CertainTeed, or equal.

2.3 ACCESSORIES

A. Nails: Standard round wire shingle type hot dipped zinc coated steel or aluminum type, of sufficient length to penetrate through roof sheathing, 3/8-inch to 7/16-inch diameter head.

B. Plastic Cement: ASTM D2822, Asphalt type with mineral fiber components, free of toxic solvents, capable of setting within 24 hours at temperatures of 75 degrees F and 50 percent RH.

C. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.

D. Ridge and Hip Vents: Plastic, extruded or formed with vent openings that do not permit direct water or weather entry; flanged to receive shingles.

E. Flashing Materials:
1. Sheet Flashings: ASTM A653/A653M, G90 (Z275); 24 gage thick precoated galvanized steel; precoating of PVC, color as chosen by owner.
2. Sheet Flashings: ASTM B209/B209M; 0.03 inch thick aluminum; precoating of PVC, color as chosen by owner.

F. Bituminous Paint: Acid and alkali resistant type; black color.

2.4 FABRICATION

A. Form flashings to profiles indicated on Drawings, and to protect roofing materials from physical damage and shed water.

B. Form flashing sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

C. Hem exposed edges of flashings minimum 1/4 inch on underside.

D. Apply bituminous paint on concealed surfaces of flashings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify roof penetrations and plumbing stacks are in place and flashed to deck surface.

C. Verify roof openings are correctly framed.

D. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.2 PREPARATION

A. Fill knot holes and surface cracks with latex filler at areas of bonded eave protection.

B. Broom clean deck surfaces under eave protection and underlayment.

3.3 INSTALLATION

A. Eave (Ice Dam) Protection Installation:
1. Place eave edge and gable edge metal flashings tight with facia boards. Weather lap joints minimum 2 inches and seal with plastic cement. Secure flange with nails.
2. Apply 4 inch wide band of plastic cement over deck flange of eave edge flashings, and embed minimum 18 inch wide strip of underlayment. Place underlayment starter strip with eave edge flush with face of flashings. Secure in place. Lap ends minimum 6 inches.
3. Apply lap cement at rate of approximately 1 1/4 gal/100 sq ft over underlayment starter strip.
4. Starting from lower edge of starter strip, lay additional 36 inch wide strips of underlayment in lap cement, to produce a two ply membrane. Weather lap plies minimum 19 inches and nail in place. Lap ends minimum 6 inches. Stagger end joints of each consecutive ply.
5. Extend eave protection membrane minimum 2 ft up-slope beyond interior face of exterior wall.

B. Protective Underlayment Installation:
1. Place one ply of underlayment over area not protected by eave protection, with ends and edges weather lapped minimum 6 inches. Stagger end laps of each consecutive layer. Nail in place.

2. Install protective underlayment perpendicular to slope of roof and weather lap minimum 4 inches over eave protection.
3. Weather lap and seal watertight with plastic cement items projecting through or mounted on roof.

C. Valley Protection Installation:
1. Place one layer of eave protection material, centered over open valleys.
2. Place one layer of sheet metal flashings, minimum 24 inches wide, centered over open valleys and crimped to guide water. Weather lap joints minimum 2 inches. Nail in place minimum 18 inches oc, 1 inch from edges.
3. Apply a 4 inch wide band of lap cement along each edge of first layer and embed ply of underlayment minimum 36 inches wide, centered. Place with mineral surface side up. Press into cement to encourage bond and nail in place minimum 18 inches oc, 1 inch from edges.

D. Metal Flashing and Accessories Installation:
1. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
2. Secure in place with nails. Conceal fastenings.
3. Flash and seal work weather tight, projecting through or mounted on roofing with plastic cement.

E. Asphalt Shingles Installation:
1. Place shingles in straight coursing pattern to match existing with 5 inch weather exposure to produce triple thickness over full roof area. Provide double course of shingles at eaves.
2. Project first course of shingles 3/4 inch beyond fascia boards.
3. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
4. Extend shingles on one slope across valley and fasten. Trim shingles from other slope 2 inches from valley center line to achieve closed cut valley, concealing the valley protection.
5. Cap hips and ridges with individual shingles, maintaining 5 inch weather exposure. Place to avoid exposed nails.
6. Coordinate installation of roof mounted components or work projecting through roof with weather tight placement of Counterflashings.
7. Complete installation to provide weather tight service.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01700 - Execution Requirements: Protecting installed construction.

B. Do not permit traffic over finished roof surface.

END OF SECTION

SECTION 07465

ALUMINUM SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes preformed aluminum siding for soffits, and fascia, with related flashings and accessory components, to be installed as a finish over continuous sheathing and trim.

B. General Requirements: Perform all work in accordance with Division One of these specifications.

1.2 REFERENCES

A. AAMA 1402.86 - Standard Specifications for Aluminum Siding, Soffit and Fascia. (American Aluminum Manufacturers Association)

1.3 COORDINATION

A. Review substrate design and details with General Contractor. Coordinate work for installation of aluminum siding system.

B. Coordinate work for installation of vapor and/or air retarders and seals.

C. Coordinate work for penetrations, openings and perimeter profiles.

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensions, layout, joints, expansion joints, construction details, methods of anchorage, and interface with adjacent materials.

B. Product Data: Submit manufacturer's product data on panels.

C. Samples: Submit two samples of siding and of siding finish, illustrating finish color, sheen, and texture.

D. Manufacturer's Installation Instructions: Submit special procedures.

E. Documentation of Qualifications and Sample Warranty.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store material in original packaging on flat surface off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation.

1.7 WARRANTY

A. Provide manufacturer's standard Lifetime Limited Warranty.

PART 2 PRODUCTS

2.1 COMPONENTS

A. MANUFACTURERS
1. Any company that meets qualifications and warranty above and can provide products per specifications below.
2. Design basis: Alcoa Building Products, Inc.

B. COMPLETE SYSTEMS
1. General: Provide complete systems of uniform material, finish and detailing, with all accessories, as recommended by selected manufacturer.
2. Profiles: As shown on drawings. If not shown, then bid the following:
   a. Fascia Profile: Smooth, Coordinate size with roof edge.
   b. Soffit Profile: Double 6-inch profile, v-groove.
   c. Soffit Venting: Provide both ventilating and non-ventilating soffit materials as needed. See drawings for ventilation requirements.
3. Texture: Smooth
4. Color: to be selected by Owner from manufacturer's standard colors.

2.2 ALUMINUM SIDING

A. Aluminum Materials
1. Tensile Stength: 28,000 psi minimum.
2. Yield Strength: 25,000 psi minimum.

B. Aluminum Fascia Sheets: nominal 0.024 inches minimum thickness.

C. Aluminum Soffit & Trim Sheets: nominal 0.019 inches minimum thickness.

D. Aluminum Finish: Corrosion-inhibiting primer plus baked-on high-performance acrylic topcoat.

2.3 ACCESSORIES

A. General purpose trim and miscellaneous components as needed for complete installation. Exposed items shall match materials, finishes and colors of adjacent siding, fascia and soffit. Include:
1. Starter strips.
2. Undersill, window and door trim.

3. Inside and outside corners.
4. J-Channels, F-Channels and similar trim as needed or shown.

B. Sealants: Specified in Section 07900; non-staining, non-shrinking and non-sagging; ultra-violet and ozone resistant; color to match siding.

C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized or stainless steel; fastener cap same color as exterior panel. Exposed fasteners same finish as panel system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Review again the concerns listed under Coordination above. Verify that building framing, sheathing, and any vapor and/or air retarder systems are acceptable to receive siding system.

B. Do not proceed until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install siding in accordance with manufacturer’s written instructions.

B. Fasten siding aligned, level, and plumb.

C. Provide sealants for weather tight installation..

3.3 CLEANING

A. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

B. Remove from site all excess material and debris caused by the work of this section.

END OF SECTION

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flashings and trim at wall and roof penetrations.

B. Seamless Gutters and downspouts.

1.2 REFERENCES

A. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate.

B. ASTM A361/A361M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding.

C. ASTM A446/A446M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

D. ASTM A526/A526M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

E. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.

H. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.

I. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

J. ASTM D2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

K. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos Free.

L. FS L-P-512 - Plastic Sheet (Sheeting), Polyethylene.

M. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant

N. CDA (Copper Development Association) - Copper in Architecture - Handbook.

O. SMACNA (Sheet Metal and Air Conditioning Contractors National Association) - Architectural Sheet Metal Manual.

1.3 DESIGN REQUIREMENTS

A. Sheet Metal Flashings: Conform to the criteria of SMACNA "Architectural Sheet Metal Manual" and the Copper Development Association "Copper in Architecture - Handbook."

B. Gutter and Downspout Components: Conform to applicable code for size and method of rain water discharge.

1.4 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Product Data: Provide data on prefabricated components.

C. Samples: Submit two samples illustrating typical seam, external corner, and internal corner, valley junction to vertical dissimilar surface, material and finish.

D. Submit two samples 3 x 6 inch size illustrating metal finish color.

1.5 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years documented experience.

1.6 PRE-INSTALLATION MEETING

A. Convene two weeks before starting work of this section.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Section 01600 - Material and Equipment: Transport, handle, store, and protect.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that may cause discoloration or staining.

1.8 PROJECT CONDITIONS

A. Coordinate with the work of other Sections.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Aluminum Sheet for gravel stops, scuppers, parapet and cap flashings: ASTM B209, 5005 alloy, H34 temper; 0.040 inch thick; shop pre-coated Kynar finish.

B. Stainless Steel: ASTM A167, Type 304, soft temper, 0.015 inch thick; smooth No. 2D finish.

C. Aluminum gutters and downspouts
   1. Formed and coated aluminum coil stock; ASTM B 209, Alloy 3105-H24

   2. Gutters:
      a. Thickness: 0.032 inch
      b. Size: 5-inch
      c. Profile: K-style (Ogee)
      d. Texture: Smooth
      e. Finish: 2 coat acrylic; applied to two sides
      f. Miscellaneous Components: Provide all necessary inside and outside corners, corner reinforcing, eave tubes, and end caps required for a complete installation
      g. Color: To be selected by owner

   3. Downspouts:
      a. Thickness: 0.019 inch
      b. Size: 3-inch by 4-inch
      c. Profile: Rectangular
      d. Texture: corrugated
      e. Finish: 2 coat acrylic;
      f. Miscellaneous components: Provide all necessary elbows, downspout offset sections, and pop rivets as required for a complete installation. All miscellaneous components shall match downspouts.
      g. Color: To match gutters

2.2 ACCESSORIES

A. Concealed Fasteners

B. Exposed Fasteners: Same material and same finish as flashing material, with soft neoprene washers.

C. Primer: Zinc molybdate type.

D. Protective Backing Paint: C-494, Bituminous.

E. Sealant: Type specified in Section 07900.

F. Bedding Compound: Butyl.

G. Surface mounted reglets: galvanized steel, rigid extruded PVC; face ends covered with plastic tape. Drive Lock DLR625 manufactured by W.P. Hackman or approved equal.

H. Recessed Reglets; Per Section 03100.

I. Gutter hangers and anchors: ASTM B 209, Alloy 3105-H24; Thickness 0.063 inch; provide types required to suit project requirements.

J. Downspout Anchors: Aluminum; provide types required to suit project requirements.

K. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.3 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate continuous cleats of same material as sheet, interlocking with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside ½ inch; miter and seam corners.

E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Fabricate corners from one piece with minimum 60 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

H. Fabricate flashings to allow toe to extent 2 inches over roofing gravel or paver. Return and brake edges.

I. Fabricate sheet metal pans (pitch pockets) 6-inch nominal size, with 3-inch upstand, and 4-inch flanges.

J. Factory weld coping cover miters, transitions and end caps prior to finishing.

K. Seal metal joints watertight.

2.4 FACTORY FINISHING

A. Class I Color Anodized Finish: Duranodic 313; integrally colored anodic coating not less than 0.7 mils thick.

B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verity roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install started and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

C. Paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mils.

3.3 INSTALLATION

A. See Section 03100 - Concrete Formwork for installation of concealed reglets.

B. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.

C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate in profiles.

E. Seal metal joints watertight.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and backing.

1.2 REFERENCES

A. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

B. ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

C. ASTM C790 - Use of Latex Sealing Compounds.

D. ASTM C804 - Use of Solvent-Release Type Sealants.

E. ASTM C834 - Latex Sealing Compounds.

F. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

G. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

H. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.

I. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

J. FS TT-S-001543 - Sealing Compound: Silicone Rubber Base.

K. SWI (Sealing and Waterproofers Institute) - Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability. Identify sealant by type as indicated in paragraph 3.6. SCHEDULE.

C. Submit samples under provisions of Section 01330.

D. Submit two sets of samples illustrating colors. Color selected by Engineer.

E. Submit manufacturer's installation instructions under provisions of Section 01330.

F. Submit manufacturer's certificate under provisions of Section 01330 that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in applying the work of this Section with minimum three years experience and approved by sealant manufacturer.

C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.

1.5 FIELD SAMPLES

A. Provide samples under provisions of Division 1.

B. Locate where directed.

C. Accepted sampled may remain as part of the Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate work under provisions of Division 1.

B. Coordinate the work of this Section with all Sections referencing this Section.

1.8 WARRANTY

A. Provide two year warranty under provisions of Section 01700.

B. Warranty: Include coverage of installed sealants and accessories that fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 SEALANTS

A. Type 1: One-Part Acrylic Terpolymer, Nonsag: FS TT-S-00230, Type II, Class A; Mono Manufactured by Tremco; or approved equal.

B. Type 2: One-Part Polysulfide, Nonsag, Not Immersible: FS TT-S-00230, Type II - non-sag, Class A; Sonolastic One Manufactured by Sonneborn; or approved equal.

C. Type 3: Multi-Part Polysulfide, Immersible: FS TT-S-00227, Type II - non-sag, I - self-leveling, Class A; Sonolastic Two Manufactured by Sonneborn; or approved equal.

D. Type 4: One-Part Polyurethane, Not Immersible: FS TT-S-00230, Type II - non-sag, I - self-leveling, Class A; Sonolastic NP-I Manufactured by Sonneborn; or approved equal.

E. Type 5: One-Part Polyurethane, Immersible: FS TT-S-00230, Type II - non-sag, I - self-leveling, Class A; Vulkem 116 Manufactured by Mameco International; or approved equal.

F. Type 6: Mildew Resistant Silicone: FS TT-S-01543, Class A, No. 786 manufactured by Dow Corning; Sanitary 1700 manufactured by General Electric, or approved equal.

G. Type 7: One-Part Silicone, Nonsag, Not Immersible: FS TT-S-01543, Class A, No. 790 manufactured by Dow Corning; or approved equal.

H. Type 8: Not Used.

I. Type 9: Multi-Part Polyurethane, Nonsag, Not Immersible: FS TT-S-00227, nonsag Type II, Mameco International Vulkem 227; or approved equal.

J. Type 10: Multi-Part Polyurethane, Nonsag, Immersible: FS TT-S-00227E, nonsag Type II, Class A; ANSI / NSF 61 approved for contact with potable water; Sikaflex –2c NS, Sonneborn Sonolastic NP-II; or approved equal.

K. Type 11: Butyl Sealant, FS-TT-S-001657, Type I; Red Devil 0697/AG; or approved equal.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ANSI/ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width; type FT manufactured by Progress Unlimited; Ethafoam SB manufactured by Dow Corning; Sonofam manufactured by Sonneborn; or approved equal.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

B. Beginning of installation means installer accepts existing surfaces and substrate.

3.2 PREPARATION

A. Clean and prime joints in accordance with manufacturer's instructions.

B. Remove loose materials and foreign matter that might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with ASTM C804 for solvent release, C790 for latex base sealant.

E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install sealant in accordance with manufacturer's instructions.

B. Measure joint dimensions and size materials to achieve 2:1 width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

D. Install bond breaker where joint backing is not used.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Tool joints concave.

3.4 CLEANING AND REPAIRING

A. Clean adjacent soiled surfaces.

B. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 PROTECTION OF FINISHED WORK

A. Protect sealants until cured.

3.6 SCHEDULE

	Location	Sealant Type
A.	Expansion/Contraction and Control Joints at:	
	Concrete Walls	7
	Concrete Floor Slabs	5
	Masonry Walls	7
	Ceramic Tile Floors	6
	Ceramic Tile Walls	6
	Exterior Insulation Finish System	7
B.	Material Joints at:	
	Metal Door, Window, and Louver Frames (Exterior)	7
	Metal Door, Window, and Louver Frames (Interior)	7
	Wall Penetrations (Exterior)	7
	Wall Penetrations (Interior)	7
	Floor Penetrations	5
	Ceiling/Roof Penetrations	7
	Sheet Metal Flashings	7
	Precast Concrete Wall Panels (Exterior)	7
	Precast/Prestressed Floor Panels (Interior)	5
	Precast/Prestressed Floor and Roof Panels (Interior)	5
	Preformed Metal Panels	7
C.	Other Joints:	
	Threshold Sealant Bed	4
	Immersed Concrete (Vertical and Sloped, not in contact with potable water)	5
	Immersed Concrete (Horizontal, not in contact with potable water)	5
	Between Counter Tops and Back-splashes	6
	Around Plumbing Fixtures	6
	Immersed Concrete (Vertical and Sloped, in contact with potable water)	10
	Immersed Concrete (Horizontal, in contact with potable water)	10

END OF SECTION

SECTION 08111

STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Thermally insulated steel doors and frames.

1.2 REFERENCES

A. American National Standards Institute
1. ANSI A250.8-2003 (R2008) – Recommended Specifications for Standard Steel Doors and Frames (SDI-100)
2. ANSI A250.11-2012 – Recommended Erection Instructions for Steel Frames

B. ASTM International
1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E413 - Classification for Rating Sound Insulation.

C. Hollow Metal Manufacturers Association
1. HMMA 810 – Hollow Metal Doors

D. National Fire Protection Association
1. NFPA 80 – Standard for Fire Doors, Fire Windows
2. NFPA 105 – Standard for Installation of Smoke Door Assemblies and other Opening Protectives
3. NFPA 252 – Standard Methods of Fire Tests of Door Assemblies

E. Steel Door Institute
1. SDI-108 – Recommended Selection and Usage Guide for Standard Steel Doors

F. Underwriters Laboratories Inc.
1. UL10B – Fire Tests of Door Assemblies
2. UL10C – Positive Pressure Fire Tests of Door Assemblies
3. UL1784 – Air Leakage Tests of Door Assemblies

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1.

B. Indicate frame elevations, anchor types and spacing, locations of cut outs for hardware, reinforcement, and finish.

C. Indicate door elevations, internal reinforcement, closure method, and cut outs for glazing or louvers, and finish

D. Submit manufacturer's installation instructions under provisions of Division 1.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ANSI A250.8.

B. Fire Rated Door and Frame Construction: Conform to the requirements of one of the following:
   1. NFPA 252, with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
   2. UL10C.

C. Fire Rated Stair Doors: Rate of rise of 450 degrees F across door thickness.
   1. Indicate temperature rise rating for stair doors.

D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

E. Attach label from agency approved by the authority having jurisdiction to identify each fire rated door and frame

F. Surface Burning Characteristics:
   1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect doors and frames with resilient packaging.

B. Break seal on-site to permit ventilation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Ceco Corporation.

B. Republic Steel Corporation.

C. Steelcraft.

D. Approved Equal.

2.2 DOORS AND FRAMES

A. Exterior Doors: ANSI A250.8, 1-3/4 inch thick.: Level 3 - Extra Heavy-duty, Model 2, seamless design, nominal 16 gage thick face sheets.

B. Exterior Frames: Level 4 for Door Model 2, nominal 14 gage thick material, base metal thickness.

2.3 DOOR AND PANEL CONSTRUCTION

A. Face: Steel sheet in accordance with ANSI A250.8.

B. End Closure: Channel, 0.042 inches thick, flush.

C. Core Construction: See schedule for core requirements.
   1. Polyurethane (U)

D. Thermal insulated door: Total “calculated” insulation R-value of R = 10 (U=0.1), measured in accordance with ASTM C518. Or a total “operable” R-value of R = 2.4 (U = 0.42), measured in accordance with ASTM C1363.

2.4 ACCESSORIES

A. Louvers: Roll formed steel, inverted 'V' blade, sightproof; 50 percent minimum free area as manufactured by Anemostat, Model CHDL-2F; Air Louvers, Inc., Model 6001A; or equal. Tamperproof fasteners. See drawings for size.

B. Glazing Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamperproof screws. See Drawings and Section 08800 for glazing size to be accommodated.

C. Silencers: Resilient rubber, fitted into drilled hole.

D. Primer: ANSI A250.10, Rust inhibitive type.

2.5 PROTECTIVE COATINGS

A. Corrosion Resistant Coating: When temperature conditions necessitate the use of anti-freezing agents in plaster or mortar, the inside of the frame shall be coated at the jobsite, by the contractor responsible for installation, with a corrosion resistant coating, such as automotive undercoating.

2.6 FABRICATION

A. Fabricate frames as welded unit.

B. Fabricate frames and doors with hardware reinforcement plates welded in place. Provide mortar guard boxes.

C. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

D. Prepare frame for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors without mullions.

E. Attach fire rated label to each frame and door unit.

F. Configure exterior frames with special profile to receive snap-in weather stripping.

2.7 SHOP FINISHING

A. Interior Units: Galvanized to ASTM A653/A653M, G60

B. Exterior Units: Galvanized to ASTM A653/A653M, G90

C. Primer: Baked.

D. Finish: Field paint as scheduled.

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify opening sizes and tolerances are acceptable.

B. Install doors and frames in accordance with ANSI A250.8.

C. Install doors in accordance with SDI-100 and DHI.

D. Coordinate with masonry construction for anchor placement.

E. Coordinate installation of glass and glazing specified in Section 08800.

F. Install door louvers, plumb and level.

G. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

H. Immediately after erection, areas where prime coat has been damaged shall be sanded smooth and touch up with same primer as applied at shop. Remove rust before above specified touch-up is applied.

3.2 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.3 ADJUSTING AND CLEANING

A. Adjust door for smooth and balanced door movement.

3.4 SCHEDULE

A. See Door and Frame Schedule on drawings for components required on this Project.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Extruded aluminum windows.

1.2 REFERENCES

A. ANSI/ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.

B. ANSI/ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

C. ANSI/ASTM E283 - Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors.

D. ANSI/ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

E. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

1.3 SYSTEM DESCRIPTION

A. Windows: Tubular extruded aluminum sections, shop fabricated, factory pre-finished, related flashings, anchorage and attachment devices.

B. Configuration: Fixed non-operable sash.

C. Glazing: Exterior.

1.4 PERFORMANCE

A. Window components to provide for expansion and contraction caused by a cycling temperature range of 170 F degrees without causing detrimental effects to components. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.

B. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated to a design pressure of 30 lb/sq ft and a suction of 30 lb/sq ft as measured in accordance with ANSI/ASTM E330.

C. Limit mullion deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

D. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.

E. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of assembly surface area, measured at a reference differential pressure across assembly of 0.3 inches water gage as measured in accordance with ANSI/ASTM E283.

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. On shop drawings, include wall opening and component dimensions; wall opening tolerances required; anchorage and fasteners; affected related work; installation requirements.

C. Submit manufacturer's installation instructions under provisions of Division One.

D. Submit samples under provisions of Division One.

E. Submit two samples 12 x 12 inches in size illustrating window frame sections, corner section and mullion section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle window units under provisions of Division One.

B. Store and protect window units under provisions of Division One.

C. Provide wrapping to protect prefinished aluminum surfaces.

1.7 WARRANTY

A. Provide five year manufacturer's warranty under provisions of Division One.

B. Warranty: Cover complete window system for failure to meet specified requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kawneer Co., Inc.

B. Winco

C. Wausau

D. Substitutions: Under provisions of Division One.

2.2 MATERIALS

A. Extruded Aluminum: ANSI/ASTM B221; 6063-T5 alloy, temper.

B. Steel Reinforcing Sections: ANSI/ASTM A36; Shapes to suit mullion sections.

2.3 FABRICATED COMPONENTS

A. Frames: Nominal 2 inches wide profile. Depth as indicated on window schedule. Flush applied glass stops of snap-on type. Exterior windows: thermally broken with interior portion of frame insulated from exterior portion,

B. Sills: Extruded aluminum; sloped for positive wash; slope depth for under sash leg to 1/2 inch beyond wall face; one piece full width of opening.

C. Hinges, Arms, Fasteners: Stainless steel.

D. AAMA certified through HC-60

2.4 ACCESSORIES

A. Between glass muntin grids: Extruded aluminum profiles, 6063-T5 alloy, temper.

2.5 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: Specified in Section 08800.

2.6 FABRICATION

A. Fabricate windows allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Rigidly fit and weld joints and corners. Accurately fit and secure corners tight. Make corner joints flush, hairline, and weatherproof. Seal corner joints with sealant.

C. Develop drainage holes with moisture pattern to exterior.

D. Prepare components to receive anchor devices. Fabricate anchorage items.

E. Prepare components with internal reinforcement for operating hardware.

F. Provide internal reinforcement in mullions with stainless steel members to maintain rigidity.

G. All frames shall have a polyvinyl chloride thermal break separator between inside and outside. When glazed with 1 inch insulating glass and tested in accordance with AAMA 1502.7 and ASTM C 236, the units shall have a minimum condensation resistance factor (CRF) of 57 and a maximum U-value of 0.56 Btu/hr/sq ft/degree F.

2.7 FINISHES

A. Exposed Aluminum Surfaces: AAMA A41 anodized to 0.7 mil minimum thickness. Color to be chosen by owner.

B. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install window frames and glazing in accordance with manufacturer's instructions.

B. Use anchorage devices to securely attach frame to structure.

C. Align window frame plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.

D. Coordinate attachment and seal of air and vapor barrier materials. Install under sill flashings.

E. Pack fibrous insulation in shim spaces at perimeter to maintain continuity of thermal barrier.

F. Install glass in accordance with Section 08800, to glazing method required to achieve performance criteria.

G. Install perimeter type sealant, backing materials, and installation requirements in accordance with Section 07900. Apply sealant to ends of sill for watertight seal.

3.3 CLEANING

A. Remove protective material from refinished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes door hardware, and all related accessories necessary for a complete hardware installation.

B. See Schedule at end of this Section for components required on This Project. (Components specified but not scheduled may be required for cutting, patching or repair.)

C. The work of this Section is governed by Division One of these specifications.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A156 - Complete Series of 24 BHMA Standards.

B. National Fire Protection Association:
1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

C. Underwriters Laboratories Inc.:
1. UL 10B - Fire Tests of Door Assemblies.
2. UL 305 - Panic Hardware.
3. UL - Building Materials Directory.

D. Warnock Hersey:
1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Warnock Hersey, or other testing laboratory approved by applicable authorities and tested in accordance with NFPA 252.

B. Accessible Openings: Provide door hardware to meet the requirements of ANSI 117.1 Section 404.

1.4 SUBMITTALS

A. Schedule: Provide detailed hardware schedule listing all hardware and accessories for each opening.

B. Product Data: Provide manufacturer's literature detailing specifications for each hardware component. Include compliance with standards and tests.

C. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, and provide electrical characteristics and connection requirements where applicable.
   2. Submit manufacturer's parts lists, templates and installation instructions.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following requirements:
   1. ANSI A156 series. (BHMA standards)
   2. NFPA 80. (Fire doors)
   3. UL 305. (Panic Hardware)
   4. ANSI 117.1 Section 404 (Accessible Doors)
   5. NFPA 101 Chapter 5 (Life Safety, Exit Doors)

1.6 QUALIFICATIONS

A. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with minimum five years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

B. Include persons involved with installation of doors, frames, and hardware.

C. Record and distribute attendance and items discussed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.9 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

B. Sequence installation to accommodate required utility connections.

C. Coordinate Owner's keying requirements during course of Work.

1.10 WARRANTY

A. Furnish two-year manufacturer warranty for locksets and door closers.

1.11 MAINTENANCE MATERIALS

A. Furnish special wrenches and tools applicable for Owner's general maintenance of each different hardware component.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Hardware Item	Acceptable Manufacturers
Hinges	McKinney, Stanley, Hager
Lockset	Adams Rite, Best
Latchset	Adams Rite, Best
Exit Devices	Von Duprin
Electric Strikes	Adams Rite, Folger Adam
Cylinders	Match those used in existing hardware.
Push/Pulls	Vistawall, Quality, Ives
Top &Bottom Bolts	Adams Rite, Glynn-Johnson, Ives
Dust-Proof Strikes	Quality, Glynn-Johnson, Ives
Surface Bolt	Ives
Closers	LCN, Norton, Rixson, ASM
Overhead Stops, Holders	Glynn-Johnson, Ives
Electromagnetic Hold-Open	LCN, Rixson
Power Assist Operator	LCN, Horton
Door Stops	Quality, Glynn-Johnson, Ives
Seals, Gaskets, Thresholds, Astragals	Pemko, NGP, Zero, Reese, ASM
Protective Plates	Hiawatha, Brookline, Quality, Ives
Lock Protectors	ASM, Glynn-Johnson, Ives
Key Cabinets	KCS, Telkee, Lund

2.2 GENERAL PRODUCT REQUIREMENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Substrate Reinforcing/Preparation: Furnished by general contractor; coordinated by hardware supplier or hardware manufacturer.
3. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
4. Fasteners and Mounting Plates: Furnish as recommended by hardware manufacturer, as required to secure hardware, and as required by job conditions.
   a. Material: Non-ferrous or corrosion resistant steel.
   b. Finish: Match hardware item being fastened.
5. Fire Ratings: Provide hardware with UL or Warnock Hersey listings for type of application involved.
6. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

2.3 HINGES AND PIVOTS

A. Butt Hinges: ANSI A156.1, full mortise type.

1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
2. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.
3. Tips: Flat button tips with matching plug.
4. Schedule:

Height of Door	Number of Hinges	Height of Hinges
Up to 60”	2	3½
Up to 90”	3	4½
Up to 120”	4	5

Width of Door	Thickness of Door	Width of Hinges	Bearings	Knuckles
Up to 36” (interior)	Up to 1⅜”	3½”	plain	2
Up to 36”	Up to 1¾”	4½”	2 ball	5
Up to 48” (interior)	Up to 1¾”	4½”	4 ball	5
Up to 48”	Up to 2¼”	5”	4 ball	5

B. Pivots: ANSI A156.1 offset full mortise pivots.
   1. Size: As recommended by pivot manufacturer for size, weight and application of door.

C. Continuous Hinges:
   1. Size: As recommended by FRP door manufacturer for size, weight and application of door.

2.4 OPERATORS

A. Locksets/Latchsets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch (70 mm) backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt. Verify type of cutouts provided in metal frames.
   1. ILCO/UNICAN L1000 Series lockset with key override functions single access code.
   2. No substitutions.

B. Exit Devices: ANSI A156.3, Grade 1 concealed vertical rod type for double doors and rim type for single doors, with push pad (paddle), unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, with dust-proof floor strikes.
   1. Types: Suitable for doors requiring exit devices.
   2. Coordinators: Furnish overhead type at pairs of doors, if required.

C. Electric Strikes: ANSI A156.5 mortised electric strikes.

D. Cylinders: ANSI A156.5, Grade 1, 7 pin type interchangeable core type cylinders.
   1. Keying: Keyed as directed by Owner. All exterior locks keyed alike. All interior locks keyed alike. Match existing system.
   2. Keys: None required – operate with existing keys.

E. Push/Pulls: ANSI A156.6; push plates minimum 0.050 inch (1.27 mm) thick. Furnish pulls with round whole section with bolts to secure from opposite door face; furnish with minimum 0.050 inch (1.27 mm) pull and push plates with beveled edges four sides unless otherwise indicated.

F. Bolts: ANSI A156.16 Grade 1 top and bottom flush bolts, with dust-proof floor strike, unless otherwise indicated.

2.5 CONTROLLERS

A. Closers: ANSI A156.4 Grade 1 closers; full rack and pinion type with steel spring, non-freezing hydraulic fluid (-30ºF to 120ºF range; -34ºC to 48ºC) and working parts enclosed in cast iron case with full non-metallic covers. Closers are required for all fire rated doors per NFPA 80 unless otherwise indicated.
   1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
   2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.

3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.
4. Operating Pressure: Maximum operating pressure as follows.
   a. Interior Doors: Maximum 5 pounds (22.2 N).
   b. Exterior Doors: Maximum 8.5 pounds (37.7 N).
   c. Fire Rated Doors: As required for fire rating, maximum 15 pounds (66.6 N).
5. Stops: Provide cushioned stop on all closers where no floor or wall stop is scheduled.
6. Hold Open: Provide hold open capability on all closers except for fire rated doors.
7. Product: LCN Cush-N-Stop or approved equal.

B. Door Controls and Overhead Holders: Furnish with accessories as required for complete operational installation.
   1. Manual Door Holders and Overhead Stops: ANSI A156.8, Grade 1 types as scheduled.
   2. Closer Holder Release Devices: ANSI A156.15 door mounted closer holder release devices designed to make swing doors close upon receiving electrical signal.
   3. Electro-Magnetic Door Holder: ANSI A156.15 wall mounted type.
   4. Power Assist Door Operators: ANSI A156.19 power mechanism which reduces opening resistance of self-closing door.
   5. Low Energy Power Door Operators: ANSI A156.19 power mechanism which opens and closes door upon receipt of signal.
   6. Low Energy Power Open Door Operators: ANSI A156.19 power mechanism, which opens self-closing door; closing of door independent of power operator.

C. Stops
   1. Wall Stops: ANSI A156.1, Grade 1, 3 inch (75 mm) wall stop convex pad wall stop with no visible screws.
   2. Floor Stops: ANSI A156.1 Grade 1 standard floor type with no visible screws; furnish with accessories as required for applications indicated.
   3. Crash Chain: heavy duty, storm type.

2.6 SEALS AND THRESHOLDS

A. Seals
   1. Weatherstripping: Furnish continuous weatherstripping at top and sides of exterior doors.
   2. Fire Rated Gaskets: Furnish continuous fire rated gaskets at top and sides of fire rated doors.
   3. Sound, Smoke and Vapor Seals: Furnish continuous seals at top and sides of doors where scheduled.
   4. Seals shall be replaceable, compressible, molded neoprene (ASTM D2000) or molded PVC (ASTM D2287).
   5. At Door Bottoms: Furnish bottom seals where weatherstripping, gaskets or seals are required AND where thresholds are provided. Furnish automatic door bottoms on doors where scheduled.

6. At Double Doors: Furnish seals at meeting styles (or an astragal if provided) where weatherstripping, gaskets or seals are required.

B. Thresholds: Maximum 1/2 inch (12 mm) height, unless otherwise indicated.

2.7 MISCELLANEOUS

A. Kickplates: Mop Plate, Armor Plate, Door Edging: ANSI A156.6, metal; size indicated in Schedule (kickplate 1 inch (25 mm) less than door width.) Minimum thickness:
1. 0.050 inch (1.27 mm) thick stainless steel
2. 0.062 inch (1.57 mm) thick brass
3. 0.125 inch (3.2 mm) thick high-impact polyethylene in color selected. Beveled edges four sides.

2.8 FINISHES

A. Finishes: As scheduled at end of this section.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

B. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
1. Locksets: 38 inch (965 mm) min, 42 inch (1 067 mm) max, to center line of strike.
2. Push/Pulls: 42 inch (1 067 mm).
3. Dead Locks: 48 inch (1 220 mm).
4. Push Pad Type Exit Devices: 42 inch (1 067 mm).
5. Cross Bar Type Exit Devices: 38 inch (965 mm) min, 40 5/16 (1,024 mm) max, to center line of strike.
6. Top Hinge: Jamb manufacturer’s standard, but not greater than 10 inches (254 mm) from head of frame to center line of hinge.
7. Bottom Hinge: Jamb manufacturer’s standard, but not greater than 12-1/2 inches (317 mm) from floor to center line of hinge.
8. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.

9. Hinge Mortise on Door Leaf: 1/4 inch (6.35 mm). to 5/16 inch (7.9 mm) from stop side of door.

3.3 FIELD QUALITY CONTROL

A. Suppliers shall inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Adjust hardware for smooth operation. Adjust lock/latch easily (not too tight) and hold door firmly (not too loose).

B. Adjust clearances between door and home (1/8 " +/- 1/16").

C. Adjust seals (weather, fire, smoke, sound, vapor) to perform properly. Replace seals which do not perform.

3.5 CLEANING AND PROTECTION

A. Clean completed work.

B. Protect installed hardware and hardware finish from damage until final acceptance.

3.6 SCHEDULE:

Set/Group #	Description	Items Required	Finish
#1	Exterior Pair	• 1.5pr Hinges (each leaf) • Classroom-Function Lockset (active leaf) • Top & Bot Bolt (inactive leaf) • Closer (active leaf) • Crash Chain (inactive leaf) • Weatherstripping (each leaf) • Threshold (entire opening)	• 32D • 26D • 26D • 26D • 26D • 26D • Mill
#2	Exterior Single	• 1.5pr Hinges • Classroom-Function Lockset • Closer • Weatherstripping • Threshold	• 32D • 26D • 26D • 32D • 32D

END OF SECTION

SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glass and glazing for hollow metal doors.

B. Glass and glazing for aluminum windows.

1.2 REFERENCES

A. ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

B. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.

C. ASTM C1036 - Flat Glass.

D. ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.

E. ASTM E546 - Test Method For Frost Point of Sealed Insulating Glass Units.

F. ASTM E576 - Test Method For Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position.

G. ASTM E773 - Test Method for Seal Durability of Sealed Insulating Glass Units.

H. ASTM E774 - Sealed Insulating Glass Units.

I. FGMA - Glazing Manual.

J. FGMA - Sealant Manual.

K. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

L. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type.

M. FS TT-S-00227 - Sealing Compound, Rubber Base, Two Component.

N. FS TT-S-00230 - Sealing Compounds, Synthetic-Rubber Base, Single Component, Chemically Curing.

O. FS TT-S-01543 - Sealing Compound, Silicone Rubber Base.

P. FS TT-G-410 - Glazing Compound, Sash (Metal) for Back Bedding and Face Glazing (Not for Channel or Stop Glazing).

Q. Laminators Safety Glass Association - Standards Manual.

R. SIGMA - Sealed Insulated Glass Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS

A. Glass and glazing materials of this Section shall provide continuity of building enclosure vapor and air barrier:
   1. Maintain continuous air and vapor barrier through-out glazed assembly from glass panel to heel bead of glazing sealant.

B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with the applicable building codes, as measured in accordance with ASTM E330.

C. Limit glass deflection to 1/200 flexure limit of glass with full recovery of glazing materials, whichever is less.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify standard available colors for selection by Owner.

D. Samples: If requested, submit two samples, 12 x 12 inch in size, illustrating glass units, coloration and design.

E. Manufacturer's Installation Instructions: Indicate special precautions required.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with FGMA Glazing Manual, FGMA Sealant Manual, SIGMA and Laminators Safety Glass Association - Standards Manual for glazing installation methods.

1.6 MOCKUP

A. Not required.

1.7 PRE-INSTALLATION CONFERENCE

A. Not required.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

1.10 COORDINATION

A. Coordinate the Work with glazing frames, wall openings, and perimeter air and vapor seal to adjacent Work.

1.11 WARRANTY

A. Provide ten year manufacturer's warranty.

B. Warranty: Include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS - FLAT GLASS MATERIALS

A. PPG Industries, Inc.

B. Libbey - Owens - Ford Glass Co.

C. Guardian Industries Corporation.

D. HGP Industries.

E. Approved equal.

2.2 FLAT GLASS MATERIALS

A. Float Glass (Type FG): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality glazing; 1/4 inch thick.

B. Safety Glass (Type SG): Clear; fully tempered with horizontal tempering; conforming to ANSI Z79.1; 1/4 inch thick.

C. Wire Glass (Type WG): Clear, polished both sides, diagonal mesh of woven stainless steel wire of ½ inch grid size; 1/4 inch thick.

2.3 MANUFACTURERS - SEALED INSULATING GLASS MATERIALS

A. PPG Industries, Inc.

B. Interpane.

C. Cardinal Insulating Glass.

D. Approved equal.

2.4 SEALED INSULATING GLASS MATERIALS

A. Insulated Glass Units (Type IG) ASTM E774 and E773; double pane with, silicone sealant edge seal; outer pane of 1/4 inch glass clear, inner pane of clear glass.

B. Insulated Tempered Glass Units (Type ITG) with Low-E: ASTM E774 and E773; double pane with silicone sealant edge seal; outer pane of 1/4 inch clear tempered glass, inner pane of 1/4 inch clear tempered glass, interpane space purged dry hermetic air; total unit thickness of 1 inch.

C. Plastic: Double glazed units with 1/4 inch air space, transparent bronze tinted sheet outside, clear sheet inside; each sheet 3/16-inch minimum thickness polycarbonate. Use "Lexan 9034" as manufactured by General Electric; or equal.

2.5 FIRE RATED GLAZING

A. 90-Minute Heat Barrier Series frame with Pyrostop Glass, by Technical Glass Products, 800-426-0279, or approved equal.

2.6 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, EPDM, 80 - 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 - 60 Shore A durometer hardness, minimum 3 inch long x one half the height of the glazing stop x thickness to suit application.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 - 15 Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot; color, black.

E. Silicone Sealant: FS TT-S-01543, Class A; single component; capable of water immersion without loss of properties; cured Shore A hardness of 15 - 25; black color.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Test samples in accordance with ANSI Z97.1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3 EXTERIOR - WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with silicone sealant.

B. Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact.

E. Install removable stops with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line.

F. Fill gap between glazing and stop with sealant to depth equal to bit of frame on glazing, but not more than 3/8 inches below sight line.

G. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with site line. Tool or wipe sealant surface smooth.

3.4 INTERIOR - DRY METHOD (TAPE AND TAPE)

A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.

B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

D. Place glazing tape on free perimeter of glazing in same manner described above.

E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

F. Knife trim protruding tape.

3.5 QUALITY CONTROL

A. Inspection will monitor quality of glazing.

3.6 CLEANING

A. Clean work under provisions of 01700.

B. Remove glazing materials from finish surfaces.

C. Remove labels after work is complete.

D. Clean glass.

3.7 PROTECTION OF FINISHED WORK

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Replacements and Repairs: Prior to acceptance of buildings, replace broken, defective, or scratched glass and repair damaged compounds.

END OF SECTION

SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior Metal Framing Systems including:
a. Interior non-load bearing steel stud partitions.
b. Ceiling suspension systems.
c. Furring.
d. Soffit and fascia framing.
2. Interior Wallboard Systems Including:
a. Gypsum and cementitious boards.
b. Joint treatment trim and tape.
c. Acoustic Insulation and Sealant.
d. Wallboard accessories.
e. Texture finish.

B. General Requirements: Perform work of this section in accordance with Division One of these specifications.

1.2 REFERENCES

A. ANSI/ASTM C36 - Gypsum Wallboard.

B. ANSI/ASTM C475 - Joint Treatment Materials for Gypsum Wallboard Construction.

C. ANSI/ASTM C630 - Water Resistant Gypsum Backing Board.

D. ANSI/ASTM C645 - Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

E. ANSI/ASTM C646 - Steel Drill Screws for the Application of Gypsum Sheet Material to Light Gage Steel Studs.

F. ANSI/ASTM C754 - Installation of Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.

G. ANSI/ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

H. ANSI/ASTM E119 - Fire Tests of Building Construction and Materials.

I. FS HH-I-521 - Insulation Blankets, Thermal (Mineral Fiber, for Ambient Temperatures).

J. GA-201 - Gypsum Board for Walls and Ceilings.

K. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

1.3 PERFORMANCE REQUIREMENTS

A. Acoustic Attenuation for Identified Interior Partitions.

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in gypsum board systems work with three years documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire rated assemblies.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division 1.

B. Indicate on shop drawings, special details associated with fireproofing and acoustic seals.

C. Provide product data on metal framing, gypsum board, accessories, joint tape and decorative finish.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GYPSUM BOARD SYSTEM

A. US Gypsum Corporation.

B. National Gypsum.

C. Georgia-Pacific.

D. Inryco-Milcor

E. Unimast Inc.

F. Approved equal.

2.2 FRAMING MATERIALS

A. Studs and Tracks: ANSI/ASTM C645; galvanized sheet steel, 25 gage thick, ‘C’ shape, with serrated faces, size as indicated.

B. Furring, Framing and Accessories: ANSI/ASTM C645.

C. Fasteners: ASTM C1002, self-drilling, self-tapping, bugle head screws. Use Type S, 1-inch long for wallboard to sheet metal and Type W, 1-1/4-inch long for wallboard to wood.

D. Adhesive: ASTM C557.

E. Wood Blocking: Construction grade softwood, fire retardant, moisture resistant treated.

2.3 GYPSUM BOARD MATERIALS

A. Standard Gypsum Board: ANSI/ASTM C36; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

B. Fire Rated Gypsum Board: ANSI/ASTM C36; fire resistive type, UL rated; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

C. Moisture Resistant Gypsum Board: ANSI/ASTM C630; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

D. Foil Faced Gypsum Board: ASTM C36; 5/8 inch thick, maximum permissible length; back surface laminated with aluminum foil; ends square cut, tapered edges.

E. Cementitious Backer Board:
   1. Material: Provide cementitious backer units complying with ANSI A118.9 and in maximum lengths to minimize end-to-end butt joints.
      a. Thickness: 5/8 inch.
      b. Width: Manufacture's standard but not less than 32 inches.
   2. Products:
      a. PermaBase Cement Board, National Gypsum Co.
      b. DUROCK Interior Cement Board, United States Gypsum Co.
      c. Dens-Shield Tile Backer, Georgia Pacific.

F. Finish Schedule

Mark	Description
GWB	Use Standard, Fire Rated or Moisture Resistant as required by application.
GMB-2	Use Cementitious Backer Board (under epoxy or ceramic tile finish).

2.4 ACCESSORIES

A. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

B. Corner Beads: Metal; 1-1/4 x 1-1/4 inch; USG Dur-A-Bead.

C. Edge Trim: GA 201 and GA 216; USG 200A, metal trim.

D. Joint Materials: ANSI/ASTM C475; reinforcing tape, joint compound, adhesive, water, and fasteners.

E. Metal Control Joint: USG No. 093, Gold Bond E-Z strip control joint, or equal.

F. Carrying Channels: Cold-rolled steel, 16 gauge, free of rust, galvanized, 1-1/2 inches deep, weighing not less than 475 pounds per 1,000 linear feet.

G. Furring Channels: Roll-formed hat shaped section of 25 gauge galvanized steel with a face width of 1-3/8 inches and a depth of 7/8 inch.

H. Resilient Furring Channels: Roll-formed section of 25 gauge galvanized steel, ½ inch depth, with 1-1/2 inches designed for resilient attachment of wallboard to framing. Use U.S. Gypsum RC-1 channel or Donn DG-8 resilient channels, or equal.

I. Tie Wire: Galvanized, soft annealed steel, 16 gauge minimum.

J. Hanger Wire: Galvanized, annealed steel, 9 gauge.

2.5 SPRAY TEXTURE

A. Use U.S. Gypsum "Imperial QT" texture finish with pearlite aggregate for ceilings and "Texture XII" sand finish for walls; Gold Bond "Perfect Spray" and "Wall Spray" texture finish; or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on Drawings.

B. Beginning of installation means acceptance of existing surfaces.

3.2 METAL STUD PARTITION INSTALLATION

A. Install studding in accordance with ANSI/ASTM C754.

B. Metal Stud Spacing: 16 inches on center.

C. Partition Heights: To 4 inches above suspended ceilings or full height to floor or roof construction above as indicated on drawings. Install additional bracing for partitions extending above ceiling.

D. Door Opening Framing: Install double studs at door frame jambs. Provide lateral bracing.

E. Blocking: Nail wood blocking to studs. Install blocking for support of plumbing fixtures, wall cabinets, toilet accessories and hardware.

F. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work placed in or behind partition framing.

3.3 WALL FURRING INSTALLATION

A. Erect wall furring for direct attachment to concrete block and concrete walls.

B. Erect wall furring channels vertically. Secure in place on alternate channel flanges at maximum 16 inches on center.

C. Space furring channels maximum 24 inches on center, not more than 4 inches from abutting walls.

D. Install thermal insulation directly attached to concrete masonry and concrete walls in accordance with manufacturer's instructions.

3.4 FURRING FOR FIRE RATINGS

A. Install furring as required for fire resistance ratings indicated.

3.5 CEILING FRAMING INSTALLATION

A. Install in accordance with ANSI/ASTM C754.

B. Coordinate location of hangers with other work.

C. Install ceiling framing independent of walls, columns, and above-ceiling work.

D. Reinforce openings in ceiling suspension system that interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.

E. Laterally brace entire suspension system.

3.6 ACOUSTICAL ACCESSORIES INSTALLATION

A. If called for on the drawings, install resilient channels at maximum 24 inches on center. Locate joints over framing members.

B. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

C. Install acoustical sealant within partitions in accordance with manufacturer's instructions.

3.7 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with GA 201 and GA 216.

B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.

D. Double Layer Applications: Use gypsum backing board for first layer, placed perpendicular to framing or furring members. Place second layer parallel to first layer. Offset joints of second layer from joints of first layer.

E. Treat cut edges and holes in moisture resistant gypsum board with sealant.

F. Place control joints consistent with lines of building spaces as indicated.

G. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

3.8 JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32 inch.

C. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

3.9 TEXTURE FINISH

A. Apply finish texture coating in accordance with manufacturer's instructions.

3.10 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers surface preparation, furnishing, and application of architectural paint and special protective coatings, complete.

B. It is the intent that all interior and exterior wood, masonry, concrete, metal, and submerged metal surfaces be painted, whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive prime coat only unless modified herein. Exterior concrete surfaces will not be painted unless specifically indicated hereinafter.

C. Abbreviations:

ANSI	American National Standards Institute
AWWA	American Water Works Association
FRP	Fiberglass Reinforced Plastic
HC1	Hydrochloric Acid
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
MIL-P	Military Specification - Paint
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council

1.2 SURFACES NOT REQUIRING PAINTING

A. Unless otherwise specifically indicated in the Technical Specifications or on the Drawings, the following areas of items will not require painting:

B. Nonferrous, corrosion-resistant metals such as aluminum and stainless steel, except where:
1. Required for electrical insulation between dissimilar metals.
2. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
3. Color coding of equipment and piping is required.
4. Architectural finish coating is required.

C. Nonmetallic materials such as glass, PVC, FRP, porcelain, and plastic except as required for architectural painting or color-coding.

D. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, prefinished metal roofing, etc., except where specified.

E. Nonsubmerged electrical conduits attached to unpainted concrete surfaces need not be painted.

F. Cathodic protection anodes shall not be painted.

G. Items specified to be hot-dip galvanized after fabrication unless specifically required elsewhere in these Specifications or subject to immersion; manufactured items and materials that are "factory" galvanized shall be prepared and coated as specified hereinafter for the exposure condition of the item and for architectural purposes unless otherwise specified herein; specifications for repair of damaged galvanized surfaces are contained hereinafter.

1.3 REFERENCES

A. ASTM International:
   1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
   2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
   3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:
   1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Painting and Decorating Contractors of America:
   1. PDCA - Architectural Painting Specification Manual.

D. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.

E. Underwriters Laboratories Inc.:
   1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.4 DEFINITIONS

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

1.5 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with at least five years experience.

B. Applicator: Company specializing in commercial painting and finishing with 3 years experience and approved by product manufacturer.

C. Quality Assurance: The paint manufacturer shall provide a representative to visit the jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract.

D. Inspection: The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any surface preparation work or coating application work. All such work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such work in his absence.

E. For all coatings subject to immersion, full cure must be obtained for the completed system. Consult the coatings manufacturer's written instructions for these requirements. The coating shall not be immersed for any purpose until completion of the curing cycle.

F. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

1.6 TESTS

A. Provide analysis and testing of coating and finish under provisions of Section 01400.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable codes for flame/fuel/smoke rating requirements for finishes.

1.8 SUBMITTALS

A. Submit product data under provisions of Section 01330.

B. Data Sheets: For each paint system used herein, the Contractor shall obtain from each paint manufacturer for submittal to the Engineer, a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers. The required information shall be submitted on a system-by-system basis. The Contractor shall also provide copies of the paint system submittals to the coating applicator. A sample PSDS form is appended at the end of this section. Indiscriminate submittal of manufacturer's literature only will not be accepted. Do not submit PSDS for paint systems not used.

C. Submit manufacturer's application instructions under provisions of Section 01330.

1.9 SAMPLES

A. The Contractor shall, prior to the start of surface preparation, furnish the Engineer with a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared by the Contractor to the specified requirements. The panel shall be representative of the steel used and shall be prevented from deterioration of the surface quality. Upon approval by the Engineer, the panel shall be preserved as a reference source for inspection.

B. Unless otherwise specified hereinafter and before any painting work is started, prepare with type of paint and application specified, and on similar substrate to which paint is to be finally applied, samples not less than 8-inch by 10-inch in size.

C. Furnish additional samples as required until colors, finishes, and textures are approved. Retain approved samples to be used as the quality standard for final finishes.

D. Mockup: Before proceeding with the work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, and workmanship. After approval, the sample spaces or items shall serve as a standard for similar work throughout the project.

1.10 FIELD SAMPLES

A. Provide samples under provisions of Section 01330.

1.11 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Store and protect products under provisions of Section 01600.

C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.

F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.12 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 60 percent, unless required otherwise by manufacturer's instructions.

C. Minimum Application Temperatures for Latex Paints: 50 degrees F unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65 degrees F unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid- height at substrate surface.

1.13 EXTRA STOCK

A. Provide a one-gallon container of each color and surface texture to Owner.

B. Label each container with color, texture, and room locations, in addition to the manufacturer's label.

PART 2 PRODUCTS

2.1 PAINT AND COATINGS SUPPLIERS

A. The letter code will be found following the generic descriptions of materials outlined in the Specifications. Address given is that of the general offices; contact these offices for information regarding the location of their representative nearest the project site.

1. Supplier Code A - Coatings Suppliers (able to supply most heavy-duty industrial coatings and architectural paints):

Ameron Protective Coatings, Brea, CA.
Carboline Coatings Company, St. Louis, MO.
DuPont Chemical Company, Wilmington, DE.
ICI Paints / Devoe Coatings, Louisville, KY.
International Protective Coatings, Houston, TX.
Plasite, Green Bay, WI.
Rustoleum Corporation, Evanston, IL.
Sherwin Williams, Cleveland, OH.
Tnemec Coatings, Kansas City, MO.
Or equal

2. Supplier Code B - Paint Suppliers (able to supply most architectural and institutional paints):

Ameritone, Long Beach, CA.
Benjamin Moore Paints, Montvale, NJ.
Detroit Graphite Company, Rockford, IL.
Fuller/O'Brien Paint Company, San Francisco, CA.
Glidden Company, Cleveland, OH
Pittsburgh Paints, Pittsburgh, PA.
Pratt and Lambert, Inc., Buffalo, NY.

Samuel Cabot, Inc., Boston, MA.
Standard Dry Wall Products, Inc., Miami, FL.
Or equal

3. Supplier Code C - Specialty Suppliers:

Darworth Company, Avon, CT
Jasco Chemical Company, Mountain View,CA
McCloskey Varnish Company, Philadelphia, PA
Olympic Stain & Varnish, Seattle, WA
Pavey Research Corporation, Tukwila, WA
Rainguard International, Conyers, GA
Sauereisen, Pittsburgh, PA
Tamms Industries, Kirkland, IL
Thoro System Products, Miami, FL
United Coatings, Greenacres, WA
Or equal

2.2 PAINT MATERIALS

A. General: All materials of a paint system, including primer and finish coats, shall be produced by the same paint manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer of the particular coating.

B. Coatings: Ready mixed, except field-catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

C. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.

D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

E. All products submitted shall conform to federal, state and local requirements limiting the emission of volatile organic compounds.

F. The following paint products are listed according to their approximate order of appearance in the paint systems. Deviations from the specified paint systems must be reviewed by the Engineer before use. The letter designating the supplier code references the listing of paint suppliers able to furnish these specific materials.

Product	Definition
Polyamide, Anti-Corrosive, Epoxy	Converted epoxy primer containing rust-inhibitive pigments, min. 50% solids by volume; certified to NSF Std. 61 for potable water service designation Supplier Code: A
Organic Zinc Rich Primer	Converted Epoxy, epoxy/phenolic or urethane type, minimum 14 lbs. metallic zinc content per gallon Supplier Code: A
Rust-Inhibitive Primer	Single-package steel primers with anti-corrosive pigment loading; may be alkyd, polyamide epoxy, epoxy ester, chlorinated rubber, minimum 30% solids by volume Supplier Code: A-B
Wash Primer	Vinyl butyral acid Supplier Code: A
Inorganic Zinc Primer	Solvent or water based, 14 lbs. metallic zinc content per gallon minimum; follow manufacturer's recommendation for top coating Supplier Code: A
Polyamide High Build Epoxy	Percent of volume solids 55% minimum, chemical resistant service. Capability of 4-7 MDFT per coat. Supplier Code: A
Polyamide Epoxy, High Solids	Percent of volume solids 70% minimum, self-priming, suitable for immersion service; certified to NSF Std. 61 for potable water service designation. Capability of 6-8 MDFT per coat Supplier Code: A
Polyurethane	Two-component, aliphatic or acrylic based polyurethane; high gloss finish, min. 55% solids by volume Supplier Code: A
Epoxy Block Filler	Two component epoxy filler/sealer; min. 70% solids by volume Supplier Code: A-B
Epoxy Floor Primer	Two component epoxy primer/sealer; 100% solids by volume Supplier Code: A-B-C

Product	Definition
Epoxy Floor Finish	Two component self-leveling epoxy floor finish; colored, smooth finish; 100% solids by volume Supplier Code: A-B-C
Canvas Sealer	Single-package latex or alkyd primer for canvas surfaces; follow manufacturer's recommendations for surface preparation Supplier Code: A-B
Alkyd Enamel (Semi-Gloss)	High quality, semi-gloss finish, percent of volume solids 45% minimum Supplier Code: A-B
Acrylic Block Filler	Primer-sealer designed for rough masonry surfaces, min. 50% solids by volume Supplier Code: A-B
Sanding Sealer	Co-polymer oil, clear, dull luster Supplier Code: A-B-C
Stain	Satin luster, linseed oil Supplier Code: A-B-C
Varnish	Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, polyurethane) available in gloss, semi-gloss, satin and flat finishes Supplier Code: A-B-C
Acrylic Latex (Gloss)	High gloss, single-component Supplier Code: A-B
Acrylic Latex (Flat)	Heavy duty exterior grade, single component Supplier Code: A-B
Acrylic Latex (Semi-Gloss)	Semi-gloss, single-component Supplier Code: A-B
Latex / Alkyd Primer/Sealer	Single-package latex or alkyd primer for gypsum or plaster surfaces; follow manufacturer's recommendations for surface preparation Supplier Code: A-B
Waterborne Epoxy Acrylic	Percent of volume solids 40% minimum, two-component waterborne epoxy acrylic, gloss. Supplier Code: A-B

Product	Definition
High Solids Water Borne Coating	100% Acrylic Emulsion Coating, 60% solids by weight Supplier Code: A-B-C
Silane-Based Water Repellent Coating	Modified polysilane / siloxane based, breathable, colorless, nonstaining, non-yellowing, deep penetrating concrete / masonry water repellent compound. Rainguard Blok-Lok, Tamms Baracade Silane, or equal. Supplier Code: C

2.3 COLORS

A. Colors to be used are shown on the Drawings and designated hereinafter.

B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials that might be affected by the presence of hydrogen sulfide or other gases likely to be present at the project.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.

D. Equipment Colors:

1. In general, mechanical equipment will be shop primed and field finished after installation. Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits. All non-submerged portions of equipment shall be painted the color as chosen by the Owner, except as itemized below:

Equipment	Color
Dangerous parts of equipment and machinery	OSHA Orange
Fire protection equipment and apparatus	OSHA Red
Physical hazards in normal operating area	OSHA Yellow

2. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.

E. Pipe Identification Painting:

1. All non-submerged metal piping except electrical conduit shall be color-coded. Metal fittings and valves shall be painted the same color as the pipe or a color chosen by the Owner.
2. Piping color-coding shall be in accordance with the Piping Schedule.

3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe will not require painting, except as noted for color-coding.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished before commencement of work. Report any condition that may potentially affect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Plaster and Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Concrete Floors: 8 percent.

D. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

3.3 ENVIRONMENTAL CONDITIONS

A. Paint shall not be applied in temperatures exceeding the manufacturer's recommended maximum and minimum allowable, nor in dust, smoke-laden atmosphere, damp or humid weather.

B. Abrasive blast cleaning shall not be performed whenever the relative humidity exceeds 85 percent, nor whenever the surface temperature is less than 5 degrees F above the dew point of the ambient air.

3.4 SAFETY

A. Painting shall be performed in strict accordance with the safety recommendations of the paint manufacturer; with the safety recommendations of the National Association of

Corrosion Engineers contained in the publication, Manual for Painter Safety; federal, state, and local agencies having jurisdiction.

3.5 PREPARATION

A. Remove electrical plates, hardware, light fixture trim, and fittings before preparing surfaces or finishing.

B. Correct minor defects and clean surfaces which affect work of this Section.

C. Shop Blast Cleaning:
1. Notify Engineer at least 7 days before start of shop blast cleaning to allow the Engineer or his representative to inspect the work during surface preparation and shop application of paints. The work shall be subject to the Engineer's approval before shipment to the jobsite.
2. Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed at the option of the Contractor. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. All work shall be blast cleaned and primed in accordance with these Specifications.
3. Finish painting at the jobsite shall be as specified herein. If the manufacturer of the finish coating differs from that of the shop primer, Contractor shall provide the Engineer with manufacturer's written confirmation that the materials are compatible.

D. Field Sandblasting: Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures, and safety equipment for personnel shall conform to the Steel Structures Painting Council.

E. Metal Surface Preparation:
1. All workmanship for metal surface preparation as specified shall be in strict conformance with the current Steel Structures Painting Council (SSPC) Specifications as follows:

Solvent Cleaning	SP 1
Hand Tool Cleaning	SP 2
Power Tool Cleaning	SP 3
White Metal Blast Cleaning	SP 5
Commercial Blast Cleaning	SP 6
Brush-Off Blast Cleaning	SP 7
Near-White Blast Cleaning	SP 10
Power Tool Cleaning to Bare Metal	SP 11
Water-jetting	SP 12

2. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in paint manufacturer's Specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
3. Hand tool clean areas that cannot be cleaned by power tool cleaning.

4. All oil, grease, welding fluxes, and other surface contaminants shall be removed as a first step in any surface preparation. Pre-blast cleaning methods shall use steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
5. Small isolated areas shall be cleaned as above or solvent cleaned with suitable solvents and clean cloths.
6. The type of equipment and speed of travel shall be such that the specified degree of cleanliness is obtained. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendations for the particular primer to be used.
7. The Contractor shall comply with all applicable federal, state, and local, air pollution and environmental control regulations for blast cleaning, and disposition of spent aggregate and debris.
8. Alternatives to standard abrasive blast cleaning methods will be permitted subject to a review by the Engineer.
9. All surfaces shall be cleaned of all dust and residual particles of the cleaning operations by dry (no oil or water vapor) air blast cleaning or other method before painting. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned.
10. Surfaces shall be painted the same day they are sandblasted. Surfaces that have started to rust before they are painted shall be re-blasted.

F. Concrete Surface Preparation (SP 13):
1. Surface preparation shall not begin until 30 days after the concrete has been placed.
2. Removal all grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
3. Concrete surfaces shall be brushoff blast cleaned to remove all curing compounds and loose concrete to provide a tooth for binding. If brushoff blasting is impractical, horizontal surfaces may be acid etched with muriatic acid solution.
4. Unless otherwise required for proper adhesion, surfaces shall be dry before painting. Moisture content of the concrete shall be 3 lbs/1000sf/24 hours emission or less prior to coating application.

G. Masonry Surface Preparation:
1. Masonry construction shall be completed and cured for 14 days or more before surface preparation work is started.
2. All oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter shall be removed by solvent, detergent washing, or other suitable cleaning methods.
3. Masonry surfaces shall be cleaned of all mortar and grout spillage and other surface deposits using either (1) nonmetallic fiber brushes and commercial muriatic acid followed with rinsing with clean water, or (2) brushoff blasting, or (3) water blasting.
4. Care shall be taken to avoid damage to the masonry mortar joints or adjacent surfaces.
5. Surfaces shall be clean and, unless otherwise required for proper adhesion, shall be dry before painting.

6. Masonry surfaces that are to be painted shall have a uniform texture and be free of surface imperfections that would impair the intended finished appearance.
7. Masonry surfaces that are to remain uncoated, or are specified to receive a clear coating, shall be free of discolorations and be uniform in texture after cleaning.

H. Plastic Surface Preparation: All plastic surfaces to be coated shall be hand sanded with a medium grit sandpaper to provide tooth for the coating system. Large areas may be power sanded or brushoff blasted, provided sufficient controls are employed so the surface is roughened without removing excess material.

I. Wood Surface Preparation:
1. Damaged wood surfaces shall be replaced or repaired in a manner acceptable to the Engineer prior to the start of surface preparation.
2. Knots and other resinous areas shall be solvent cleaned (mineral spirits) and coated with shellac or other knot sealer, prior to painting. All pitch shall be removed by scraping and wiped clean with mineral spirits or turpentine prior to applying the knot sealer.
3. All sharp edges shall be rounded by light sanding prior to priming.
4. After priming, all cracks, holes, and other surface irregularities shall be filled flush with the surrounding surface and sanded smooth. The filler shall be a wood putty approved by the paint manufacturer for the paint system. For natural finishes, the color of the wood putty shall match the color of the finished wood.
5. Fill all holes flush with a synthetic-based wood putty. Putty shall be applied before or after the prime coat, depending on compatibility and the putty manufacturer's recommendations.
6. Cellulose type putty shall be used for stained wood surfaces.
7. Surfaces shall be clean and dry prior to painting.

J. Dry Wall:
1. Normally, new gypsum wallboard surfaces need no special preparation before painting. All surfaces should be dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.
2. Joints between panels should be reinforced and carefully concealed. Fastener heads should be covered. Sand joint compound with fine grit sandpaper to produce a smooth, flat surface.
3. Water-resistant gypsum wallboard is a special grade produced for use in areas involving frequent contact with water. Latex or water-thinned paint products are not recommended for applications to this type of wallboard. Only solvent type paints and coatings should be used.

K. Preparation of Existing Coated Surfaces:
1. Existing primed surfaces to be final coated shall be detergent washed and freshwater rinsed. Loose, abraded, or damaged coatings shall be cleaned to substrate by Hand or Power Tool, SP 2 or SP 3. Surrounding intact coating shall be feathered. One spot coat of the specified primer shall be applied to bare areas overlapping the prepared existing coating. One full finish coat of the specified finish coat(s) shall be applied overall. Pre-primed ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.
2. Brushoff Blast Cleaning: The equipment, procedure, and degree of cleaning shall conform to the Steel Structures Painting Council Surface Preparation 7,

Brushoff Blast Cleaning. The abrasive may be either wet or dry blasting sand, grit, or nut shell. The various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface shall be selected such that the surface is cleaned without pitting, chipping, or otherwise damaging the surface. The Contractor shall verify his parameter selection by blast cleaning a trial area that will not be exposed to view. The trial blast cleaned area shall be subject to the approval of the Engineer and shall be used as a representative sample of the surface preparation.

L. Acid Etching: After pre-cleaning, the following solution is spread by brush or plastic sprinkling can: 1 part commercial muriatic acid reduced by 2 parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HC1. Workmen shall be equipped with necessary protective clothing. The application rate shall be approximately 2 gallons per 100 square feet. Work the acid solution into the surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained. The acid will react vigorously for a few minutes, during which time brushing is continued. After the bubbling has subsided (10 minutes), hose down the remaining slurry with high pressure clean water. Rinsing must be done immediately to avoid formation of salts on the surface that are difficult to remove. Thorough rinsing is necessary to remove any residual acid surface condition that can impair adhesion. The surface shall be completely dry before coating is applied. After etching, the surface shall be "grainy" to the touch. If not, repeat the treatment.

M. Solvent Cleaning: Solvent cleaning shall consist of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by the use of solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action. This method conforms to Steel Structures Painting Council SP 1.

N. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply wash primer immediately following cleaning.

O. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.

P. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of wash primer.

3.6 PROTECTION

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Openings in motors shall be masked to prevent paint and other materials from entering the motors.

B. Repair damage to other surfaces caused by work of this Section.

C. Provide drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site.

3.7 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Comply with the manufacturer’s directions regarding re-coat time frames.

F. Allow applied coat to dry before next coat is applied.

G. Multiple-component coatings shall be prepared using all of the contents of the container for each component as packaged by the paint manufacturer. No partial batches will be permitted. Multiple-component coatings that have been mixed shall not be used beyond their pot life. The Contractor shall provide small quantity kits for touch up painting and for painting other small areas. Only the components specified and furnished by the paint manufacturer shall be mixed. No intermixing of additional components for reasons of color or otherwise, even within the same generic type of coating, will be permitted.

H. Shop Primed or Factory Finished Surfaces: All shop primed or factory finished items shall be inspected at the jobsite for compliance with these Specifications. Schedule such inspection with the Engineer in advance. Abraded areas on factory-finished items shall be repaired in strict accordance with the equipment manufacturer's directions. Repaired areas shall be carefully blended into the original finish.

I. Film Thickness:
   1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC. The number of coats is the minimum required irrespective of the coating thickness. Additional coats may be required to obtain the minimum required paint thickness, depending on method of applications, differences in manufacturer's products, and atmospheric conditions. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.
   2. Film thickness measurements and electrical inspection of the coated surfaces shall be performed with properly calibrated instruments. Recoat and repair as necessary for compliance with the Specifications. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.
   3. Concrete, nonferrous metal, plastic, and wood surfaces shall be visually inspected to ensure proper and complete coverage has been attained.
   4. Particular attention shall be given edges, angles, flanges, etc. Where insufficient film thicknesses are likely to be present, ensure proper millage in these areas.

J. Porous Surfaces: Porous surfaces such as concrete, masonry, etc., may have the prime coat thinned to provide maximum penetration and adhesion. Type and amount of thinning shall be determined by the paint manufacturer and is dependent upon the surface density and type of coating.

K. Damaged Coatings:
1. Damaged coatings, pinholes, and holidays shall have the edges feathered and repaired in accordance with the recommendation of the paint manufacturer, as reviewed by the Engineer.
2. All finish coats, including touch up and damage-repair coats shall be applied in a manner that will present a uniform texture an color-matched.

L. Unsatisfactory Application:
1. If the item has an improper finish color, or insufficient film thickness, the surface shall be cleaned and top coated with the specified paint material to obtain the specified color and coverage. Specific surface preparation information to be secured from the coating manufacturer and the Engineer.
2. All visible areas of chipped, peeled, or abraded paint shall be hand or power sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required by the Engineer.
3. Work shall be free of runs, bridges, shiners, laps, or other imperfections. Evidence of these conditions shall be cause for rejection.
4. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.
5. Leave all staging up until the Engineer has inspected the surface or coating. Staging removed before approval by Engineer shall be replaced.

3.8 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, and material that may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.9 PROTECTIVE COATINGS SYSTEMS

System No.	Title
1	Submerged Metal - Potable Water
2	Submerged Metal - Sewage
5	Exposed Metal - Mildly Corrosive
6	Exposed Metal - Atmospheric

System No.	Title
8	Buried Metal - General
10	Galvanized Metal Conditioning
11	Galvanized Metal Repair
17	Special Coating – Concrete
20	Immersion Service – Concrete
22	Chemical-Resistant Wall – Concrete
23	Chemical-Resistant Wall - Concrete Masonry
26	Canvas Jacketed Pipe
27	Aluminum and Dissimilar Metal Insulation

A. System No. 1, Submerged Metal - Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5)	Polyamide, Anti-Corrosive, Epoxy Primer, Potable Water Service	1 coat, 5 MDFT
	Polyamide Epoxy, High Solids, Potable Water Service	1 coat, 5 MDFT

B. System No. 2, Submerged Metal - Sewage:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5)	Polyamide Epoxy, High Solids	2 coats, 14 MDFT

C. System No. 5, Exposed Metal - Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Surface Prep. for System No. 10 for Galvanized or Copper Surface	Polyamide, Anti-Corrosive Epoxy Primer or System No. 10 for Galvanized or Copper Surfaces	1 coat, 3 MDFT
	Polyamide High Build Epoxy	1 coat, 5 MDFT

D. System No. 6, Exposed Metal - Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Rust-Inhibitive Primer or System No. 10 for Galvanized or Copper Surfaces	1 coat, 3 MDFT
	Polyamide High Build Epoxy	1 coat, 5 MDFT
	Polyurethane	1 coat, 2 MDFT

E. System No. 8, Buried Metal - General:

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Polyamide Epoxy, High Solids	2 coat, 14 MDFT

F. System No. 10, Galvanized Metal Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP1)	Wash Primer	1 coat, 0.4 MDFT
Followed by Hand Tool (SP 2) or Power Tool (SP 3)	Finish Coats: See System Nos. 5 and 6	

G. System No. 11, Galvanized Metal Repair:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1) Followed by Hand Tool (SP 2), Power Tool (SP 3), or Brushoff Blast (SP 7)	Organic Zinc Rich Primer	1 coat, 3 MDFT

H. System No. 17, Special Coating - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Epoxy Floor Primer	1 coat, 10 MDFT
	Epoxy Floor Finish	2 coats, 10 MDFTPC

Note: Apply finish coat with scattered decorative paint chips on coated surface.

I. System No. 20, Immersion Service - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Polyamide Epoxy High Solids	1 coat, 3 MDFT
	Polyamide Epoxy High Solids	1 coat, 8 MDFT

J. System No. 22, Chemical-Resistant Wall - Concrete:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Epoxy Block Filler	1 coat, As required to Fill Voids
	Polyamide Epoxy High Build	1 coat, 300 SFPG
	Polyamide Epoxy High Build, Gloss	1 coat, 160 SFPG

K. System No. 23, Chemical-Resistant Wall - Concrete Masonry:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete Masonry	Epoxy Block Filler	1 coat, As Required to Fill Voids
	Polyamide Epoxy High Build	1 coat, 300 SFPG
	Polyamide Epoxy High Build, Gloss	1 coat, 160 SFPG

L. System No. 26, Canvas Jacketed Pipe Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Remove All Oil and Grease	Canvas Sealer	1 coat, 200 SFPG
	Acrylic Latex	2 coats, 240 SFPGPC

M. System No. 27, Aluminum and Dissimilar Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP1)	Wash Primer	1 coat, 0.4 MDFT
	Polyamide Epoxy, High Solids	1 coat, 10 MDFT

3.10 ARCHITECTURAL PAINT SYSTEMS

System No.	Title
105	Wood, Stained and Varnished (Interior)
107	Metal Trim and Structural Steel
109	Concrete Masonry, Gloss
110	Concrete Masonry, Exterior
113	Concrete, Gloss
115	Gypsum Wallboard & Plaster, Gloss

System No.	Title
120	Exterior Concrete Tank Coating
125	Exterior Masonry Water Repellent Coating

A. System No. 105, Wood, Stained and Varnished (Interior or Exterior):

Surface Prep.	Paint Material	Min. Coats, Cover
Wood	Interior Stain	Match Sample
	Sanding Sealer	1 coat, 450 SFPG
	Varnish Interior – Polyurethane satin Exterior – Alkyd gloss	2 coats, 450 SFPGPC

B. System No. 107, Metal Trim and Structural Steel

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 6)	Rust-Inhibitive Primer	1 coat, 2 MDFT
Pickle (SP 8)	Alkyd Enamel (Semi-Gloss)	2 coats, 4 MDFT

C. System No. 109, Concrete Masonry, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Masonry	Epoxy Block Filler	1 coat, as required to fill voids
	Waterborne Epoxy Acrylic (Gloss)	1 coat, 3 MDFT

D. System No. 110, Concrete Masonry, Exterior:

Surface Prep.	Paint Material	Min. Coats, Cover
Masonry	Acrylic Bock Filler	1 coat, 75 SFPG

	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

E. System No. 113, Concrete, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Waterborne Epoxy Acrylic (Gloss)	2 coats, 5 MDFT

F. System No. 115, Gypsum Wallboard and Plaster, Gloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Dry Wall	Alkyd Primer/Sealer	1 coat, 350 SFPG
	Waterborne Epoxy Acrylic (Gloss)	1 coat, 3 MDFT

G. System No. 120, Exterior Concrete Tank Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	High Solids Water Borne Coating	2 coats, 300 SFPGPC

H. System No. 125, Exterior Masonry Water Repellent Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	Silane-Based Water Repellent Coating	1 coat, 150 SFPGPC

3.11 PAINT APPLICATION SCHEDULE

A. Unless otherwise indicated in the Specifications or on the Drawings, the work shall be painted or coated in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

B. System No. 1, Submerged Metal - Potable Water: This system shall be used on the following items or areas:
1. Not Used.

C. System No. 2, Submerged Metal - Sewage: This system shall be used on the following items or areas:

1. All metal surfaces below a plane 1 foot above the maximum liquid surface, all metal surfaces above the maximum liquid surface that are a part of the immersed equipment, all concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, except, reinforcing steel; and the following specific surfaces shall receive this system:
   a. All metallic items in manholes and wetwell.

D. System No. 5, Exposed Metal - Mildly Corrosive: This system shall be used on the following items or areas:

1. Exposed metal surfaces located inside of structures and enclosures, and the following specific surfaces shall receive this system:
   a. All new equipment and motors inside of structures.
   b. Exposed new and modified metallic non-stainless steel and plastic piping, valves, and all unfinished miscellaneous metal associated with the piping inside structures.
   c. All exposed structural steel columns, roof supports, and all other exposed steel members.
   d. Surfaces designated on Interior Finish Schedule.

E. System No. 6, Exposed Metal - Atmospheric: This system shall be used on the following items or areas:

1. Exposed metal surfaces located outside of enclosed structures and exposed to weather, including metal doors and frames, vents, louvers, flashings, sheet metalwork, lintels, and miscellaneous architectural metal trim, and the following specific surfaces shall receive this system:
   a. Exposed new and modified non-stainless steel metal piping, valves, and all unfinished miscellaneous metal associated with the piping outside enclosed structures and exposed to weather.
   b. All new equipment and motors outside of enclosed structures.
   c. All guard posts and hydrants.
   d. Surfaces designated on Exterior Finish Schedule.

F. System No. 8, Buried Metal - General: This system shall be used on the following items or areas:

1. All buried, below grade portions of steel items, except buried stainless steel or ductile iron.

G. System No. 10, Galvanized Metal Conditioning: This system shall be used on the following items or areas:

1. All galvanized surfaces requiring painting and the following specific surfaces shall receive this system:
   a. As primer for all galvanized and copper surfaces scheduled to receive System Nos. 5 and 6.
   b. Underside of exposed metal roof decking.

H. System No. 11, Galvanized Metal Repair: This system shall be used on the following items or areas:

1. All galvanized surfaces that are abraded, chipped, or otherwise damaged.

I. System No. 17, Special Coating - Concrete: This system shall be used on the following items or areas:
   1. All floors and surfaces designated on the Interior Finish Schedule.

J. System No. 20, Immersion Service - Concrete: This system shall be used on the following items or areas:
   1. Not Used.

K. System No. 22, Chemical-Resistant Wall - Concrete: This system shall be used on the following items or areas:
   1. Not Used.

L. System No. 23, Chemical-Resistant Wall - Concrete Masonry: This system shall be used on the following items or areas:
   1. Not Used.

M. System No. 26, Canvas Jacketed Pipe: This system shall be used on the following items or areas:
   1. Outside surfaces of all exposed canvas jacketed insulated piping.

N. System No. 27, Aluminum and Dissimilar Metal Insulation: This system shall be used on all nonsubmerged concrete embedded aluminum surfaces, and the following items or areas:
   1. All contacts between dissimilar metals.
   2. All aluminum surfaces in contact with concrete or masonry.

O. System No. 105, Wood, Stained and Varnished: This system shall be used on the following items or areas:
   1. All interior and exterior wood surfaces.
   2. All exposed glue-lam wood surfaces – one finish coat of varnish after erection.

P. System No. 107, Metal Trim and Structural Steel: This system shall be used on the following items or areas:
   1. Interior metal doors and frames (Unless noted otherwise on Interior Finish Schedule), and miscellaneous metal trim exposed to view.
   2. Overhead cranes and monorails.
   3. Note: Structural steel are covered under System No. 5.

Q. System No. 109, Concrete Masonry, Gloss: This system shall be used on the following items or areas:
   1. All interior concrete masonry unit walls as indicated in the Interior Finish Schedule.

R. System No. 110, Concrete Masonry, Exterior: This system shall be used on the following items or areas:
   1. Not Used.

S. System No. 113, Concrete, Gloss: This system shall be used on the following items or areas:
   1. Interior concrete walls and ceilings as indicated in the Interior Finish Schedule.

T. System No. 115, Gypsum Wallboard and Plaster, Gloss: This system shall be used on the following items or areas:
   1. All gypsum wallboard and plaster walls and ceilings as indicated in the Interior Finish Schedule.

U. System No. 120, Exterior Concrete Tank Coating: This system shall be used on the following items or areas:
   1. Not used.

V. System No. 125, Exterior Masonry Water Repellent Coating: This system shall be used on the following items or areas:
   1. Not used.

(See PSDS form following this section)

END OF SECTION

PAINT SYSTEM DATA SHEET

Attached products' Technical Data Sheet (if applicable) to this sheet for each paint system submittal.

Paint System Number (from spec.) _____

Paint System Title (from spec.) _____

Coatings Supplier _____

Representative _____

Surface Preparation _____

Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

SECTION 10552

FIRE EXTINGUISHERS
AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers

B. Accessories.

1.2 REFERENCES.

A. NFPA 10 - Portable Fire Extinguishers.

B. UL 711 - Rating and Fire Testing of Fire Extinguishers.

C. UL 299 - Dry Chemical Fire Extinguishers.

D. UL 1093 - Halogenated Agent Fire Extinguishers.

1.3 QUALITY ASSURANCE

A. Conform to NFPA 10 and UL 711 requirements for extinguishers and fire blankets.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01300.

B. Include physical dimensions, operational features, color and finish, anchorage details, rough-in measurements, location, and details.

C. Submit manufacturer's installation instructions under provisions of Section 01300.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit manufacturer's operation and maintenance data under provisions of Section 01730.

B. Maintenance Data: Include test, refill or recharge schedules, procedures, and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperatures may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Modern Metal Products.

B. J. L. Industries.

C. Larsen's Manufacturing Company.

D. Substitutions: Under provisions of Section 01600.

2.2 EXTINGUISHERS

A. For all hand extinguishers, provide heavy-duty brackets with clip-together strap for wall mounting. All extinguishers shall have UL listing and be charged and ready for service.

B. Multi-Purpose Hand Extinguisher (F EXT): Tri-class dry chemical extinguishing agent in pressurized, red enameled steel shell cylinder; activated by top squeeze handle; agent propelled through hose or opening at top of unit; for use on A, B, and C class fires; minimum UL rating 4A-60B:C, 10-pound capacity.

PART 3 EXECUTION

3.1 INSPECTION

A. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install fire extinguisher bracket plumb and level on wall, 36 inches from finished floor to bottom of fire extinguisher.

B. Secure rigidly in place in accordance with manufacturer's instructions.

C. Install fire extinguishers in all new buildings; mount on wall inside each exterior man door.

END OF SECTION

SECTION 11316

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Submersible Pumps:
1. 9th Avenue Lift Station:
a. Lift Station Pump No. 1: P-1-1.
b. Lift Station Pump No. 2: P-1-2.
c. Lift Station Pump No. 2: P-1-3.
2. Major components included, but not limited to:
a. Pump and motor.
b. Mounting system.
c. Mix flush valve.
d. Wet Well and Valve Vault Access Covers.
e. Instrumentation and control.
f. Spare parts.

1.2 SYSTEM DESCRIPTION

A. The lift station pumps will pump residential and commercial wastewater at a collection system lift station.

1.3 REFERENCES

A. Hydraulic Institute Standards.
1. ASTM A 108 - C41 - Specification for Steel, Carbon, Cold-Rolled Standard Quality.
2. ASTM A 48 - Gray Iron Castings.
3. AFBMA Std. 9 - Load Ratings and Fatigue Life for Ball Bearings.
4. AFMBA Std. 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.4 DESIGN REQUIREMENTS

A. General Requirements:
1. Liquid pumped: Raw Sewage.
2. Pump Installation: Submersible.
3. Specific gravity of liquid: 1.0.
4. Maximum liquid temperature (F): 100.
5. Percent solids (%): <0.5.
6. Discharge size (inch): 6-inch.
7. Suction size (mm): 150.
8. Solids Handling: Minimum 3-inch compressible soft solids.

B. Hydraulic Requirements:
1. Primary Design Condition (two pumps operating):

a. Flow, gpm: 778.
b. TDH, feet: 120.
c. Specific energy, kWh/US MG: 634.

2. Secondary Design Condition (one pump operating):
   a. Flow, gpm: 1,140
   b. TDH, feet: 103
   c. Specific energy, kWh/US MG: 485.
3. Minimum shutoff head, feet: 162.

1.5 SUBMITTALS

A. Include all submersible pumps in a single submittal package. Partial or incomplete submittals will not be reviewed.

B. Shop drawings: Submit under provisions of Division 1, including the following:
   1. Complete performance curves showing:
   2. Capacity.
   3. Head.
   4. Horsepower.
   5. Efficiency.
   6. Pump data and dimensions.
   7. Impeller type.
   8. Motor data.

C. Submit operations and maintenance manual under the provisions of Division 1.

D. Submit certificates of proper installation and operator training under provisions of Division 1.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Flygt Xylem, Pewaukee, WI.

B. Or Equal.

2.2 GENERAL

A. All equipment shall be the end product of one pump system manufacturer. The manufacturer shall be responsible for the complete system including all items covered herein and in the Detailed Specification Section.

2.3 METAL FABRICATION

A. Furnish metal parts described herein conforming details in the Drawings.

B. Anchor bolts, fasteners, nuts, and washers: 316 stainless steel.

2.4 EQUIPMENT

A. Motors:
1. Motor nameplate horsepower: 54 HP.
2. Type drive: Adjustable Speed.
3. Motor shall be inverter duty rated and meet NEMA MG1, Part 31.
4. Motor rpm: 1785 rpm.
5. 460 VAC, three phase, 60 Hz.
6. Moisture resistant Class H insulation.
7. Continuous duty, 30 starts per hour.
8. Enclosure: Submersible.
9. Rating: Class 1, Div. 1, Groups C & D.
10. Service Factor: 1.15.
11. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered, throughout the entire pump performance range.
12. Temperature sensors embedded in motor windings.
13. Motor shaft: AISI Type 431 Stainless Steel.
14. Premium efficiency motor 95%.

B. Electrical Power and Signal Cable:
1. Type: Water proof.
2. Power cord entry to pump: Protected with a compression fitting consisting of a single cylindrical elastomer grommet flanged with washers to provide ease of changing the cable.
3. Length (each): 100 feet.

C. Pump Construction:
1. Pump volute, motor and seal housings:
   a. Construction: Close-grained cast iron ASTM A 48 Class 35B.
   b. Seals: External mating parts machined and fitted with Nitrile or Viton rubber O-rings.
   c. Exposed fasteners: AISI Type 316 stain-less steel.
2. Shaft:
   a. Construction: AISI Type 431 Stainless Steel.
3. Shaft bearings:
   a. Provide an upper and lower set of bearings that compensate for axial thrust and radial forces, AFBMA 9 and AFBMA 11.
   b. Bearing life: B-10 life of 50,000 hours AFBMA 9 and AFMBA 11
   c. Lubrication: Permanently grease lubricated.
4. Mechanical seal:
   a. Number of seals: Two.
   b. Type: Mechanical with tungsten carbide versus tungsten carbide seal faces for the lower primary seal, and tungsten carbide versus tungsten carbide for the upper secondary seal faces.

c. Mounting: Tandem with an oil chamber between seals.
d. Lubrication: Oil bath.

5. Impeller:
   a. Construction: ASTM A532 (Alloy IIIA) 25% chrome cast iron RC 60.
   b. Impeller type: Semi-open, multi-vane backswept design. Leading vane edges hardened to RC 45.
   c. Balancing: Dynamically balanced.

D. Base Elbows and Mounting System:
1. Discharge elbow: 6-inch
   a. Provide vertical discharge with 6-inch ANSI 125 pound flange.
   b. Construction: Closed-grained cast iron ASTM A48 CL30.
   c. Include guide rail lower mounting fitting.
2. Guide rails:
   a. Number of guide rails per pump: 2.
   b. Length, feet: See Drawings.
   c. Construction: 3-inch 316 stainless steel.
   d. Provide a 40 foot stainless steel lifting cable for each pump. Provide stainless steel cable holders.
3. Include upper and intermediate guide rail supports for each pump.

2.5 ACCESSORIES

A. Mix Flush Valve:
1. Provide Flygt Mix-Flush Valve(s), or approved equal, for the pumps.
2. Provide valve mounted directly on volute of one of the pumps for a duplex station and on two of the pumps for a triplex station.
3. Valve shall be positioned so as to provide non-clogging operation and discharge greater part of pumped volume into sump to flush solids into suspension at each pumping cycle.
4. Valve shall be open at start of each pump cycle and close under full pump discharge pressure.
5. Valve open time shall be adjustable.
6. Valve shall operate by liquid being pumped and through a self-contained hydraulic system. No external power source shall be required to operate valve.

B. Access Covers
1. Provide access cover for lift station as shown on drawings and described herein. Coordinate installation of access covers in precast concrete covers.
2. Access covers shall be EJ Group Inc. Style “ALN3” or approved equal.
3. Access covers shall provide combined covering of the opening and fall through protection in accordance with O.S.H.A. Standards 1910.23 and 1910.146.
4. Material shall be 6061-T6 aluminum for bars, angles and extrusions. Diamond plate shall be 1/4" type 5086 aluminum.
5. Covers shall be designed to withstand a minimum live load of 300 pounds per square foot.
6. Each cover shall be designed using a maximum design stress of 17,300 PSI with a safety factor of 2.2 applied to a minimum allowable tensile strength.
7. Channel frame shall be of extruded aluminum with a continuous 1-1/4" anchor flange and must be cast into and supported by concrete. The channel frame shall

be a minimum of 1/4" thick, with a minimum cross section of 7.5" and shall have a dove tail groove to accept a 1/8" silicone cushion gasket. Underside of frame shall have a 1-1/2" drain coupler for pipe connection.

8. Each door shall have a heavy-duty stainless steel pneu-spring and shall be counterbalanced for ease of operation with opening cover.
9. Each door shall be equipped with a grade 316 stainless steel open arm and shall lock open in the 90-degree position. Each hold open arm shall have a red vinyl grip handle and shall be fastened to the frame with a ½" grade 316 stainless steel bolt.
10. Hinges shall be of the heavy-duty design, brass alloy with a 65,000 PSI tensile strength. Each hinge shall have a 3/8" grade 316 stainless steel pin and shall be bolted to the channel frame and diamond plate with grade 316 stainless steel bolts and ny-lock nuts.
11. Each cover shall be supplied with a grade 316 stainless steel slam lock with keyway protected by a threaded aluminum plug. Plug shall be flush with top of 1/4" diamond plate. Slam lock shall be fastened with four grade 316 stainless steel bolts and washers.
12. Each cover shall be equipped with an aluminum lift handle. The lift handle shall be flush with the top of the 1/4" diamond plate.
13. Each cover shall be equipped with a safety grate made of 6061-T6 aluminum with a minimum ultimate strength of 38,000 PSI and minimum yield strength of 35,000 PSI per ASTM B221, and shall be designed to withstand a minimum live load of 300 pounds per square foot. Deflection shall not exceed $1/50^{th}$ of the span.
14. Grate openings shall be 5"x 5", which will allow for maintenance inspections and limited maintenance while safety grate fall through protection is left in place.
15. Safety grate design must assure that the fall through protection is in place before the doors can be closed thereby protecting the next operator.
16. Each grate shall be provided with a permanent hinging system that will lock the grate in the 90-degree position once opened, thereby creating a physical barrier around the opening.
17. Each grate shall have an opening arm with a red vinyl grip handle that will allow opening of the grate while providing the grate as a barrier between the operator and the pit. The opening arm shall also be equipped with a controlled confined space entry lock (lock provided by others). This locking device will prevent unauthorized entry to the confined space.
18. Grate shall be painted with OSHA type safety orange paint promoting visual awareness of the hazard.

C. Spare Parts:
1. Gaskets and O-ring seals: One set per pump.
2. Mechanical seal: One set per pump.

2.6 FINISHING

A. Shop and Field Painting: Acrylic dispersion zinc phosphate primer with a polyester resin paint finish. Minimum finish thickness of 6 mils.

2.7 INSTRUMENTATION AND CONTROL

A. Pump Control Sensors:

1. Moisture Detectors: Provide in motor stator chamber.
   a. Upon the moisture sensors sensing moisture in the stator chamber, the controls shall shut down the pump, indicate pump fail alarm, and activate the remote common fail.
2. Temperature Sensors: Provide thermal switches for each phase in pump motor.
   a. Upon the temperature sensors sensing a high temperature in the motor stator, the controls shall shut down the pump, indicate pump fail alarm, and actuate the remote common fail. Automatically reset when temperature returns to normal.
3. Provide Flygt Mini CAS Relay with each pump to be mounted in respective Power Panel or Local Control Panel as shown on drawings
   a. Other pump manufacturers to provide similar moisture and motor high temperature protection relay(s) to MCC supplier to provide separate moisture and high temperature signals.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with the Drawings, shop drawings and manufacturer's instructions.

B. Level bases and grout with non-shrinking grout.

3.2 MANUFACTURER'S SERVICES

A. Provide manufacturer's services under provisions of Section 01445.

B. Minimum Service Requirements:

1. Installation: As required for proper installation.
2. Start-up and Field Testing: One half day on site.
3. Operating Training: One half day on site.

C. Service to Repair Defective Work: Provide during one-year warranty period under the provisions of the General Conditions.

END OF SECTION

SECTION 13320

LIFT STATION PUMP CONTROL AND SCADA

PART 1 GENERAL

1.1 WORK DESCRIPTION

A. This section covers work necessary for the installation, field testing, startup, training, and final documentation for the Grafton River Bend Lift Station and SCADA.

B. The Lift Station Pump Control Panel shall be added to the existing radio/PLC based Supervisory Control and Data Acquisition (SCADA) system for the VILLAGE OF GRAFTON, WISCONSIN.

C. This section covers all software and programming required for the installation and commissioning of the new Lift Station control panel which includes but is not limited to the following:

1. Programming and startup of the Lift Station Pump Control and SCADA Panel which includes full function PLC programming and Operator Interface Touchscreen programming. (NOTE: The programming is to include all the described functions plus mirror the functions of the owners 11th Avenue, Bridge Street and Green Bay Road Sites.)

D. Programming for the SCADA master will be provided by the owners SCADA programmer via cash allowance listed on the bid form which includes but is not limited to the following:

1. SCADA system master computer software and programming upgrades required to add Lift Station to the system. (NOTE: The programming is to include all the described functions plus mirror the functions of the owners 11th Avenue, Bridge Street and Green Bay Road Sites.)
2. SCADA system master radio telemetry software and programming upgrades required to add Lift Station to the system. (NOTE: The programming is to include all the described functions plus mirror the functions of the owners 11th Avenue, Bridge Street and Green Bay Road Sites.)

E. Requirements for the electrical work associated with the installation of the SCADA system and associated instrumentation equipment are as specified in Division 16000 ELECTRICAL.

1.2 RESPONSIBILITY FOR COMPLETE SYSTEM

A. The Contractor shall be responsible for and shall provide for the design, supply, delivery, installation, certification, calibration, adjustment, software configuration, testing, startup, owner training, warranty and routine future field services, of a complete coordinated system which shall perform the specified functions.

B. The Contractor shall provide the Owner with all services and hardware to ensure that proper communications are established at the Lift Station.

1.3 APPROVED SYSTEMS INTEGRATORS

A. KAMP/Synergy/Energenecs

B. Starnet

1.4 SUBMITTALS

A. Hardware Submittals:
   1. Submittals shall include full details, shop drawings, catalog cuts and such other descriptive matter and documentation as may be required to fully describe the instruments provided per these specifications.

B. Software Submittals:
   1. Submittals shall include PLC program printout, Touchscreen screen shot printouts showing each screen displayed as the operator will see them displayed as well as a written submittal explaining how to operate and use Touchscreen, After this submittal is approved by engineer, this data plus PLC and Touchscreen program copies o on CD or flash drive are to be put is O&M Manual.

C. O&M Manuals
   1. Copy of updated O&M Manuals.

1.5 ON SITE SUPERVISION

A. The Contractor shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the SCADA system. The personnel shall be present on-site as required to effect a complete and operating system.

1.6 TESTING AND STARTUP

A. All elements of the SCADA system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All special testing materials and equipment shall be provided by the Contractor. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner.

B. The contractor shall provide checkout sheets for all I/O and control functions associated with the Lift Station.

1.7 TRAINING

A. The training program shall educate operators, maintenance, engineering, and management personnel with the required levels of system familiarity to provide a common working knowledge concerning all significant aspects of the system being supplied. The training program shall consist of one 2-hour secession.

1.8 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall update the existing O&M manuals as necessary to add the new as-built Lift Station panel drawings and software submittal data as described in the SUBMITTALS section of the specification.

1.9 DEFINITION OF ACCEPTANCE

A. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
   1. All O&M documentation for the pump controls and SCADA has been submitted, reviewed and approved.
   2. The SCADA system, pump controls and instrumentation have successfully completed all testing requirements specified herein and have successfully been started up.
   3. All Owner's staff personnel training programs have been completed.
   4. Owner/Engineer sign a document indicating that the pump controls and SCADA system has formally been accepted.

PART 2 PRODUCTS

2.1 GENERAL

A. The functions and features specified herewith are the minimum acceptable requirements for the SCADA system. The provided system shall equal or exceed each requirement.

B. In some cases, the specifications may allow the accomplishing of certain functions by means of more than one hardware/firmware/software approach. Any approach that is proposed shall equal or exceed all functional, operational, convenience and maintenance aspects of the one described. All proposed changes to the design shall be approved by the engineer.

C. Major equipment, component and software items are specified; however the Contractor shall, at no additional cost, provide all appurtenant items, whether specifically referenced herein or not, but which may be required for operation as hereinafter specified.

2.2 DEVICE COMMISIONING AND STARTUP

A. Provide and install and commission Five Float Switches as shown on the drawings.

B. Provide and install and commission Level Transmitter as shown on the drawings.

C. Provide and install and commission Magnetic Flow Meter as shown on the drawings.

D. Provide and install and commission Three Pump Seal Failure and Pump Motor High Temperature to miniCAS monitoring systems which are to be mounted in the Lift Station Control Panel as shown on the drawings.

E. Provide Rockwell Automation Power Monitor 5000 in a separate NEMA 3R control panel. Connect Power Monitor to PLC via Ethernet connection to new Ethernet industrial switch. Provide all and install all required CTs, PTs, etc. at the service entrance for the station.

F. Install per all equipment per manufacturers instructions.

G. Provide and install and commission intrinsic safe barriers for all float switches and level transducer.

2.3 FUNCTIONAL DESCRIPTIONS

A. The SCADA System Master Computer shall be updated to include screens for the New Lift Station. Screens shall be provided with the same level of detail as provided for other lift stations on the system.

B. The SCADA System Master PLC Operator Interface shall be updated to include screens for the New Lift Station. Updates shall be provided with the same level of detail as provided for other lift stations on the system.

C. SCADA system shall display the following parameters at the Lift Station local Operator Interface Touchscreen and at the SCADA system Master Computer and at the Master PLC Operator Interface Terminal:
1. Pump Station Wet Well Level
2. Pump Station Flow
3. Pump Station Flow Total
4. Station Voltage Phase A-B
5. Station Voltage Phase B-C
6. Station Voltage Phase C-A
7. Station Phase A Current
8. Station Phase B Current
9. Station Phase C Current

D. SCADA system shall display a graphic picture of the Lift Station at the SCADA system Master Computer, Master PLC Operator Interface Terminal and at the Lift Station local Operator Interface Touchscreen. Graphics shall include all lift station pumps, piping, generator, transfer switch and all have indications for all status, alarm and station analog values.

E. Provide the following Lift Station SCADA Status/Alarm indications at the Master Computer, Master PLC Operator Interface and at the Lift Station local Operator Interface Touchscreen as listed below:
1. Pump 1 Run
2. Pump 2 Run
3. Pump 3 Run
4. Pump 1 Elapse Time Meter (Calculated at Master)
5. Pump 2 Elapse Time Meter (Calculated at Master)
6. Pump 3 Elapse Time Meter (Calculated at Master)
7. Pump 1 Fail
8. Pump 2 Fail

9. Pump 3 Fail
10. Pump 1 Seal Fail
11. Pump 2 Seal Fail
12. Pump 3 Seal Fail
13. Pump 1 Motor Overtemp
14. Pump 2 Motor Overtemp
15. Pump 3 Motor Overtemp
16. Wetwell Low Water Alarm (Lowest Level Float Switch)
17. Wetwell High Water Alarm (Highest Level Float Switch)
18. Power Failure
19. Station Phase A Failure
20. Station Phase B Failure
21. Station Phase C Failure
22. Station Voltage Phase A-B Low/High
23. Station Voltage Phase B-C Low/High
24. Station Voltage Phase C-A Low/High
25. Station Phase A Current High
26. Station Phase B Current High
27. Station Phase C Current High
28. Valve Room Motion Sensor Alarm
29. Generator Room Motion Sensor Alarm
30. Valve Room Door Switch Alarm
31. Generator Room Door Switch Alarm
32. Valve Room Flood Alarm
33. Valve Room Low Temperature Alarm
34. Generator Room Low Temperture Alarm
35. Float Backup Active Alarm
36. Generator Run
37. Generator Fail

F. Update all master computer printed reports as necessary to include Lift Station.

G. Provide HOA switch controls on the Lift Station Operator Interface Touchscreen for each pump. The HOA shall allow a pump to run in hand, or turn a pump off or run a pump in Automatic from the Touchscreen. This function shall be disabled and controls returned to automatic if there is an abnormal water level.

H. Provide Daily Reset Button on the Lift Station Operator Interface Touchscreen. The daily reset button will move daily values to the yesterday values for Pumps and Generator runtimes and cycles and for the flow meter tantalizer. The reset button will also reset all of these daily values to zero. If the reset button has already been pushed, or the time is past 9:00AM, this function will not work until the next day at midnight.

I. Program Lift Station PLC and display on Lift station Operator Interface Touchscreen controls such that the PLC shall start and stop Pumps 1 and 2 and 3 based on submersible level transmitter setpoints with the following selections:
1. Pump 1 Lead - Pump 2 Lag1 - Pump 3 Lag2
2. Pump 1 Lead - Pump 3 Lag1 - Pump 2 Lag2
3. Pump 2 Lead - Pump 1 Lag1 - Pump 3 Lag2
4. Pump 2 Lead - Pump 3 Lag1 - Pump 1 Lag2

5. Pump 3 Lead - Pump 1 Lag1 - Pump 2 Lag2
6. Pump 3 Lead - Pump 2 Lag1 - Pump 1 Lag2
7. Alternate Pumps 1, 2, 3. After first pump starts, subsequent pumps shall be added in numerical order.

J. When the lead pump is started the pump shall start at minimum speed. As level in wetwell increases to next level stage, pump shall ramp up in speed and shall be at maximum speed when second stage level is reached. When the Lag 1 level is reached the second pump will start and the pumps will ramp up and down in the same control band and at the same speed to maintain wetwell level. When the Lag2 level is reached the third pump will start and the pumps will ramp up and down in the same control band and at the same speed to maintain wetwell level. Pumps are to stop one at a time when all running pumps are at minimum speed after an operator adjustable time delay for each level stage.

K. Provide operator adjustable maximum run timers and minimum and maximum pump speed setpoints for each pump.

L. Provides level setpoint entry for each stage as follows:
1. Lead Pump Start Level
2. Lag1 Pump Start Level
3. Lag2 Pump Start Level
4. Lead Pump Stop Level
5. Lag1 Pump Stop Level
6. Lag2 Pump Stop Level

M. Provides low low level setpoint entry which will stop all pumps.

N. When pump(s) in auto the PLC level control system shall normally control the pumps. The Backup Level control system shall control the pumps in situations where the PLC or level transmitter experiences a failure. The hardwired backup shall automatically take over operation of the pumps if the level in the wetwell reaches LSH 1-1 or LSLL 1-1 Float Switch. When this happens the PLC shall be sent a signal that the Float Backup is active so it does not attempt to control the pumps causing control conflicts. The Float mode shall stay active until the Float Backup Reset Button is pushed. Whenever the Float Backup is active Front of Panel Pilot Light shall also be active. Float LSC 1-1 shall start lead pump and LSC 1-2 shall start lag 1 pump and LSC 1-3 shall start lag 2 pump. LSL 1-1 shall stop both pumps. The Backup system will start the VFDs at full speed. Pumps shall time on in 10 second intervals after a power failure condition occurs. Coordinate and fully test backup float system with PLC powered and not powered. Pumps shall run at full speed when in backup mode with digital output from panel wired to VFDs digital input and VFD programmed to run at full speed when signal from LCP-1 is received.

O. Float Backup system shall have a Front-of Panel 3 position selector switch for Lead, Lag 1 and Lag 2 as follows:
1. Left Position sequence 1 - 2 - 3
2. Center Position sequence 2 - 3 - 1
3. Right Position sequence 3 - 1 - 2

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate all work with the engineer/owner to avoid conflicts, errors, delays and unnecessary interference with operation of the existing system during installation, testing, cutover and startup.

B. Install all new equipment in accordance with the manufacturer's instructions and approved submittals.

END OF SECTION

SECTION 13322

PLC SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the Programmable Logic Controller (PLC) Systems and PLC Operator Interface Systems.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS

A. PLC’s shall meet national and international standards including DIN, UL, CSA, FM and ISO 9001.

B. PLC's shall consist of a CPU with adequate memory, instruction set, power supplies, local and remote input/output modules, communications modules and hardware, and all other components required to make the unit perform all of the functions required. Unit shall be capable of providing the specified communication, monitoring, display, input/output, annunciation, computational and other requirements for operation of the Control system and associated Network.

C. System components including CPU, power supply, signal modules, function modules and communications modules and shall be DIN rail mounted.

D. One licensed copy of programming software shall be provided with the system to the owner. Provide license, manuals, programming cable(s) and program CD(s).

E. Provide serial and Ethernet ports as necessary to interface to Radio, Operator Interface.

F. Provide separate programming port which does not require disconnecting Radio or Operator Interface to program.

G. PLC Manufacturer: Allen-Bradley(Rockwell) Micrologix 1400 model same or better as installed on existing SCADA lift stations.

2.2 OPERATOR INTERFACE TERMINALS

A. Unit shall be capable of displaying process variables, fault messages, and provide process control using touch-screen programmed keys. A built-in interface port shall allow connection of a printer for printing hard copy and message printouts. Furnishing of the printer itself is not required under this contract.

B. Color Graphic Screen Type.

C. Provide adequate memory for all specified functions.

D. Control shall be via touch screen technology.

E. Units shall be Color with a minimum screen size of 10 inch wide screen or larger.

F. Display programming shall be via Microsoft Windows based software. All Operator interface terminals shall be programmed with the same software package.

G. One licensed copy of programming software shall be provided with the system to the owner. Provide license, manuals, programming cable(s) and program CD(s).

H. Operator Interface Manufacturer: Maple Systems.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 13323

RADIO SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the fabrication, engineering, wiring and installation for radio system as described in the Specifications and as shown on the Drawings.

B. Provide antenna cabling, antenna, antenna lightning arrestor protection, antenna mounting hardware, antenna mounting structure, radio power supply, data cabling and connectors.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 RADIO TRANSCEIVER

A. Radio Transceiver shall be a MDS/GE Transnet 900Mhz Unlicensed with same features as used for the existing radio system at Grafton.

B. All radio connections shall be via plug-in connectors. This requirement applies to the coaxial cable feed line, antenna connections, lightning arrestor connections, radio power and data connections.

C. Provide all required Programming software, Diagnostic software and Programming cable.

2.2 ANTENNA SYSTEMS

A. Furnish and install a YAGI directional antenna on the top of the antenna structure shown on the drawings. Antennas and supporting structures shall be designed to withstand a 100 MPH wind with a 1" coating of ice.

B. Antenna cable shall be LMR-400 or better as required to provide a solid communication link between the Antennas and Radio.

C. Provide main antenna copper wire ground system with 10Ft. ground rod.

D. Provide lightning arrestor mounted in enclosure where radio is mounted.

2.3 PATH STUDY AND LICENSING

A. The system supplier shall include performing a path study for the new radio site utilizing:
   1. Area topographic maps
   2. Site names/locations and addresses
   3. Site ground and building/pole elevations
   4. Latitude and Longitude for each site
   5. Approximate path length

B. The system supplier shall be responsible for obtaining all required license modification associated with additional radio site. The system supplier shall be responsible for the following:
   1. Obtain FCC approval for system operation modification
   2. Prepare all materials required by the FCC
   3. Obtain all license application forms, write in all required information and forward to the owner for signature(s)
   4. Provide all information required by the area frequency coordinator.
   5. Programming radio as required.
   6. Programming other radios in system to become repeaters or perform other to radio programs as necessary to add site to system.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 13325

CONTROL PANEL ENCLOSURE CONSTRUCTION

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for the fabrication, engineering, wiring and installation for instrumentation, control, electrical enclosures, SCADA field panels and Local Control Panels as described in the Specifications and as shown on the Drawings.

B. Panels provided under this section shall meet the requirements of UL-508. All panels shall bear the UL-508 serialized label or be third party certified when delivered to the job site. All field modifications shall be in conformance with UL-508. When the Owner accepts the panels, the contractor shall certify that the panels have retained their UL labeling or third party certification.

C. All wiring shall be in complete conformance with the National Electric Code, state, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCTS

2.1 GENERAL

A. All outdoor enclosures shall be NEMA 4X stainless steel, provided with stainless steel pedestal if not mounted on wall.

B. All indoor enclosures shall be NEMA 12, except in wet areas panels shall be NEMA3R and in corrosive atmospheres indoor panels shall be NEMA 4X stainless steel.

C. All conduit entry into the enclosures shall be sealed with non-hardening sealing compound.

D. Condensation protection shall be provided. Enclosure shall have a heater which operates continuously to prevent condensation build-up. Exception to this requirement may be given if panel is in an electrical room with heating and air conditioning.

E. Enclosures shall be provided with internal heaters, heater thermostats, heat pipe type air to air heat exchangers, heat exchanger thermostat as necessary to main internal panel temperatures between 40 and 104 Degree F.

F. All equipment in enclosures shall operate from single 120 Vac power supply circuit. (If panel contains motor controls, panel shall have a single supply at the voltage of the motor controls. Provide control transformer as necessary to provide control panel with 120Vac control voltage.)

G. Acceptable enclosure manufacturers:
   1. Hoffman Engineering Company
   2. Or approved equal

H. Acceptable heater manufacturers:
   1. Hoffman Engineering Company
   2. Or approved equal

I. Acceptable heat exchanger manufacturers:
   1. Hoffman Engineering Company
   2. Noren Products Incorporated
   3. Or approved equal

2.2 PANEL CONSTRUCTION

A. NEMA 12 and 3R Enclosures
   1. Fabricated from 12 gauge cold rolled sheet steel or better.
   2. Stiffening members shall be provided for strength and stiffness as required.
   3. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
   4. Lifting rings shall be provided for panels in excess of 100 pounds.
   5. Double doors shall be of the flush type construction with continuous hinge and gasketing.
   6. Doors shall be equipped with two (wall mounted) or three (floor mounted) point latching mechanism.
   7. A hasp and staple shall be provided for padlocking.
   8. Subpanels shall be provided, and mounting shall be designed for easy removal.
   9. A print pocket shall be attached to the inside of each door.

B. NEMA 4X Enclosures
   1. NEMA 4X enclosures shall be fabricated from 14 gauge stainless steel or better.
   2. Stiffening members shall be provided for strength and stiffness as required.
   3. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
   4. Lifting rings shall be provided for panels in excess of 100 pounds.
   5. Enclosure door shall be provided with neoprene gasket, which shall be attached to the enclosure with oil-resistant adhesive, and held in place with stainless steel retaining strips.
   6. Door clamps shall be provided on three sides of the enclosure door. (EXCEPTION: Panels with internal swing-out doors shall be provided a single

door handle to allow easy access to swing-out door mounted operator interface devices.)

7. A hasp and staple shall be provided for padlocking.
8. Subpanels shall be provided as required, and its mounting shall be designed for easy removal.
9. Corrosion inhibitors and breather drains shall be furnished for condensation and corrosion control inside the panel.
10. A print pocket shall be attached to the inside of each door.

2.3 PANEL GROUNDING

A. Each enclosure shall be provided with an isolated ground connection or buss, which shall be tied to the installation grounding system, through a #6 AWG insulated grounding conductor, only at the final connection to the ground rods.

2.4 PANEL WIRING

A. Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.

B. Not more than two wires shall be terminated at any terminal block.

C. Wiring splices and wire nuts will not be permitted within the enclosure.

D. Wiring within the enclosure shall be protected as follows:
1. In general, all wiring within the enclosure shall be put in plastic wiring ducts such as panduits.
2. Wiring outside of the ducts shall be restrained by means of plastic ties.
3. Wiring passing a door hinge shall be grouped and wrapped in a protective wire harness.
4. Provide abrasion protections for any wire bundles passing through holes or across sheet metal edges.

E. In general, wiring within the enclosures shall be as follows:
1. Control wiring within the enclosure shall be #18 AWG stranded.
2. Wiring for long distance DC signals shall be #18 AWG stranded.
3. Wiring for 4 20 mA DC analog signals shall be #18 AWG twisted shielded pair.
4. Multi-conductor control cables and shielded pair cables between control equipment, control panels and motor starters shall be rated for 600 Volts.

F. Wiring within the enclosure shall follow the following color convention:
1. Neutral conductor shall be white.
2. Hot or phase conductor shall be black.
3. Grounding conductor shall be green.
4. AC control wiring shall be orange
5. DC (+) power conductor shall be red.
6. DC (-) power conductor shall be black.
7. DC control wiring shall be blue
8. Current Loop wiring shall be twisted shielded pair cables.

G. AC and DC wiring shall be separated from each other. Where AC and DC wire runs parallel, the minimum separation between them shall be 4 inches. Where AC and DC wire runs across, they shall cross at 90 degree intersections. Provide separate panduit for AC and DC wiring.

H. Equipment and signal ground wiring, as well as Neutral wiring shall not be daisy-chained. They shall each be terminated at isolated, bused terminal blocks.

I. Each conductor end shall be terminated at a terminal block or at an equipment wiring terminal. Each terminal block shall have a unique identification number. The terminal blocks shall be arranged and numbered in consecutive order, based on standard alphanumeric order.

J. Terminal blocks within each enclosure shall be grouped as follows:
   1. 120 Volts AC power
   2. 120 Volts AC control wiring terminal blocks
   3. AC isolated Neutral Busbar terminations
   4. 24 Volts DC power terminations
   5. 24 Volts DC control wiring terminal blocks for discrete signals
   6. 24 Volts DC Common Busbar terminations
   7. Analog signal wiring terminal blocks (for 4 - 20 mA DC signals)
   8. Isolated Grounding Busbar terminations

K. Provide 25% spare terminal blocks, (minimum of 6), for each type used in each enclosure.

2.5 TERMINAL BLOCKS

A. Terminal blocks within enclosures shall be of the high density modular types, constructed of nylon material, suitable for mounting on standard DIN rails. Termination type shall be tubular screw with serrated pressure plate.

B. All current carrying parts (metal bodies) shall be made of nickel/¬tin-plated copper.

C. Ground terminals shall be color coded in accordance with international standard, which shall be yellow/green.

D. Panel power distribution and digital output terminal blocks shall be fused lever disconnect type with illuminated blown fuse indication.

E. The terminal block system shall be as manufactured by Phoenix Contact or equal.

2.6 PANEL POWER DISTRIBUTION REQUIREMENTS

A. Panels shall always be designed to have one power supply source. If supply voltage is higher than 120Vac a control transformer with 100% spare capacity shall be supplied.

B. One GFI Service outlet shall be supplied inside each panel.

C. Panels with Uninterruptible Power Supply (UPS) shall be designed such that if the UPS system fails a contactor at the output of the UPS shall transfer the panels UPS powered loads back to the panels Utility power supply. Panel shall provide a “UPS Fail” contact closure alarm prewired to a terminal strip for connection to the SCADA system or other alarm system.

2.7 PANEL ACCESSORIES

A. Each enclosure that requires cooling shall be provided with a thermostat and a thermostatically controlled air-to-air heat exchanger.

B. Each enclosure shall be provided with internal panel fluorescent lights, which shall be provided with and actuated through a door light switch. The lights shall turn on automatically when the enclosure door is opened and turn off automatically when the enclosure door is closed. The panel lights shall be strategically placed to provide maximum possible illumination coverage of the panel/enclosure interior.

C. The enclosure System Integrator shall provide for all interposing relays which may be necessary to interface all field equipment or Motor Control Centers, to provide a complete functional system.

D. The enclosure System Integrator shall provide for all intrinsic safety relays and panel construction methods which are necessary to interface with field equipment and instruments that are mounted in explosion hazard areas. See NEC for requirements.

E. The enclosure System Integrator shall provide for all analog signal boosters and isolators which may be necessary to interface all field instrumentation equipment or Motor Control Centers, to provide a complete functional system.

F. Current to current isolators shall be furnished and installed as required, to eliminate interface and ground loop problems. Inputs shall be 4 - 20 mA DC. Outputs shall be 4 - 20 mA DC isolated, into at least 800 Ohms. Power to the isolators shall be 115 Volts AC, 60 Hertz.

G. The enclosure System Integrator shall provide and size all instrument loop power supplies. The enclosure System Integrator shall provide and size all PLC and Operator Interface Power Supplies. The power supplies shall be sized to include at least 100% spare capacity. Where PLC manufacturer and Operator Interface Manufacturer’s recommend separate power supplies for isolation or other reasons separate power supplies shall be provided.

H. PLC, Operator Interfaces and each type of I/O shall have separate fusing or breakers as required by manufacturer instruction manuals or as necessary to eliminate electrical ground loops or electrical/communication noise.

I. Provide communication port optical isolation to ensure proper communications between networked devices.

2.8 EQUIPMENT IDENTIFICATION AND WIRE TAGGING

A. All panel wiring shall be identified by means of heat shrink or other non fade type wire markers. Wire markers shall be printed in an easy read font.

B. All communications cabling shall be identified by means of heat shrink type wire markers. Cable markers shall be printed in an easy read font

C. Each component mounted within the enclosure shall be provided with equipment identification. Equipment and device nameplates or identification shall be of engraved laminated plastic, black lettering on white background or similar professional looking identification.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 13326

CONTROL PANEL MOUNTED INSTRUMENTS AND DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for panel mounted instruments and devices.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCT

2.1 INSTRUMENT INDEX

A. Furnish, install, engineer, wire, adjust, test, start-up, commission, and train operations personnel for panel mounted control devices as listed below:

2.2 PUSH BUTTONS, SELECTOR SWITCHES, PILOT LIGHTS

A. General Specifications
   1. All panel mounted control devices shall be of the industrial grade, heavy duty, watertight/oiltight types. They shall be rated NEMA 4, 4X and 13, corrosion resistant. In explosion hazard areas they shall be rated NEMA 7.
   2. Each panel mounted control device shall be provided with three ply engraved laminated plastic, (white-black-white) legend plate. The legend plate size shall be 2 1/2" by 2 1/2" nominal.
   3. Each panel mounted control device shall be provided with an engraved laminated plastic nameplate on the rear of the device, mounted on the inside of the enclosure door.

B. Push Buttons and Selector Switches
   1. Contact ratings shall be as follows:
      a. Make: 60 Amperes at 120 Volts AC (7200 VA), at 35% power factor
      b. Break: 6 Amperes at 120 Volts AC (720 VA), at 35% power factor
      c. Continuous: 10 Amperes at 120 Volts AC, at 75% power factor
   2. Guards shall be provided as follows:
      a. Stop momentary push buttons: Full guard types
      b. Start momentary push buttons: Extended guard types
      c. Lamp test momentary push buttons: No guard
   3. Emergency Stop push buttons shall be of the maintained push-pull types, provided with mushroom illuminated button.

4. Button colors shall be as follows:
    a. Start button: Red
    b. Stop button: Green
    c. Emergency stop button: Red, illuminated
    d. Lamp test button: Black
    e. Selector switch: Black

C. Pilot Lights
1. All pilot lights shall have LED light units.
2. All pilot lights shall be of the push-to-test types.
3. Color caps shall be as follows:
    a. Motor ON: Red
    b. Motor OFF: Green
    c. Motor failure: Amber

D. MANUFACTURER:
1. Square D, Class 9001
2. Allen-Bradley
3. Cuttler-Hammer
4. Or equal

2.3 GENERAL PURPOSE CONTROL RELAYS

A. General Specifications
1. Contacts: Silver Cadmium Oxide, minimum configuration: Double Pole Double Throw or Three Pole Double Throw rated 10 Amps continuous at up to 240VAC, 10 million operation minimum life.
2. Pin and socket configuration: 8-pin or 11-pin tube type, single or double tier, snap mount DIN rail socket.
3. Relays shall have integral pilot lights, which shall be on when its coil is energized.
4. Relay Coils directly connected to Programmable Controller Outputs shall be provided with a shunt load resistor and an MOV type surge protector, or surge diode designed per PLC manufacturer instruction manuals.
5. MANUFACTURER: Square D, Class 8501, Type K or equal.

2.4 GENERAL PURPOSE TIME DELAY RELAYS

A. General Specifications
1. Contacts: Silver Cadmium Oxide, minimum configuration: Double Pole Double Throw or Three Pole Double Throw, rated 10 Amps continuous at up to 240VAC, 10 million operation minimum life.
2. Transient Protected. 2000Volts for 100us
3. Provide as required in the following configurations:
    a. On Delay
    b. Off Delay
    c. Interval
    d. One Shot
    e. Repeat Cycle

4. Pin and socket configuration: 8-pin and 11 pin socket type, single or double tier, snap mount DIN rail socket.
5. Time Delay Relays shall have integral Knob(s) Adjustment on top of relay which shows timing range.
6. Time Delay Relay Coils directly connected to Programmable Controller Outputs shall be provided with a shunt load resistor and an MOV type surge protector, or surge diode designed per PLC manufacturer instruction manuals.
7. MANUFACTURER: Square D, Class 9050, Type JCK or approved equal.

2.5 INTRINSIC SAFETY BARRIERS

A. General Specifications
1. DIN rail mounting.
2. Short circuit protected.
3. FM, UL, CSA, approved for application.
4. Shock resistant encapsulated design.
5. MANUFACTURER: STAHL, GEM, or equal.

2.6 DC REGULATED POWER SUPPLIES

A. General Specifications
1. When DC power supply is required for discrete inputs and 2-wire analog loops, provide linear regulated 24 Volt DC regulated power supplies. Output Regulation to +/- 5% with input of 105 -125Vac.
2. When DC power supplies of other voltages are required, provide as necessary.
3. The power supply shall be sized to include 100 percent spare capacity.
4. Encapsulated with terminal strips, no soldering.
5. Short circuit protected.
6. Overvoltage protected.
7. MANUFACTURER: Acopian, Sola or equal.

2.7 AC TRANSIENT SURGE PROTECTORS

A. General Specifications
1. DIN Rail Mountable
2. Voltage Input: 120 VAC, 60 Hz, single phase
3. Current Capacity: 30Amp
4. Clamping Voltage: 330
5. Surge Dissipation to 10KA
6. LED replacement indicator light
7. MANUFACTURER: Citel, Or Equal.

2.8 UNINTERRUPTIBLE POWER SUPPLIES

A. General Specifications
1. Sized to allow a minimum 60 minutes operation. (Minimum of 700 VA)
2. Supplied for all PLCs, Switches, Routers, Modems, Radios, Operator Interfaces, Touchsreens and Computers in system. Also, backup to maintain operation of every input and output shown on P&IDs.
3. One-line high frequency double conversion technology.

4. Input Power Factor correction.
5. Sine-wave power output from inverter.
6. External power connector to allow external additional battery connection.
7. 2-year warranty.
8. Battery to be maintenance free sealed leakproof.
9. Fused or circuit breaker input protection.
10. 0-40 Degrees C Operating Temperature.
11. Output to have electronic overload and short circuit protection. Overload 110% for 10sec then automatic transfer to bypass. Bypass transfer time 0ms.
12. Dip switch selectable output voltage 100/110/120/127Vac.
13. MANUFACTURER: Powerware, Or Approved Equal.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 13327

FIELD MOUNTED INSTRUMENTS AND DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification covers the technical requirements for field mounted instruments and devices.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1.
   2. Section 13320 General Instrumentation and Control

PART 2 PRODUCT

2.1 INSTRUMENT INDEX

A. Furnish, install, engineer, wire, adjust, calibrate, test, start-up, commission, and train operations personnel for field instrumentation and control devices as listed below:

2.2 FLOAT SWITCH

A. General Specifications:
   1. The float switches shall be of the normally open or normally closed non-mercury type switch rated for 20 Amperes at 120 Volts AC.
   2. The float switches shall be constructed of 20 gauge 316 stainless steel, 5 or 5-1/2 inch diameter sphere permanently assembled to switch cable.
   3. The float switches shall be provided with a grounding wire.
   4. The float switch cable shall be type SO with a Nitrile PVC jacket containing three #14 AWG fine stranded conductors (black, white and green).
   5. Each float switch shall be provided with all required mounting hardware as specified in the "INSTALLATION NOTES" section of this form.

B. Acceptable Manufacturer:
   1. Siemens, formerly Consolidated Electric Company (Model 9G-EF)
   2. Anchor Scientific (Eco-Float)
   3. Or Approved Equal

C. Equipment Data:

TAG NO.	PROCESS
LSLL-1	Wetwell Low Level Alarm

TAG NO.	PROCESS
LSL-1	Wetwell Pump Stop
LSC-1-1	Wetwell Lead Pump Start
LSC-1-2	Wetwell Lag 1 Pump Start
LSC-1-3	Wetwell Lag 2 Pump Start
LSH-1	Wetwell High Level Alarm

D. Installation Notes:
1. Install per manufacturer's instructions.
2. Provide and install wall mounted stainless steel pipe or hanging stainless steel cable on which the float switches shall be mounted.
3. All hardware shall be stainless steel including bracket anchors.

2.3 SUBMERSIBLE LEVEL TRANSMITTERS

A. General Specifications:
1. The hydrostatic level is sensed by a pressure transducer. The assembly shall consist of a submersible sensor suspended by a cable. The assembly shall be FM rated and CSA approved to be intrinsically safe.
2. Accuracy: Plus or minus 0.5 percent of full scale overall span.
3. Temperature Limits: -10 to 100 degrees F.
4. Temperature Effects: Less than plus or minus 2 percent.
5. Sensor Construction: 316 stainless steel with 2.5 inch diaphragm made of material suitable for wastewater.
6. Cable between sensor and transmitter shall be provided as required.
7. Transmitter to have digital display calibrated to engineering units. Transmitter enclosure shall be rated NEMA 4X.
8. Transmitter shall operate from 120Vac power supply.
9. Transmitter shall have integral intrinsic safe relay so sensor can be mounted in hazardous (Classified) areas.
10. Transmitter Isolated Output: 4-20 mA.

B. Acceptable Manufacturer:
1. Contegra Model SLX 130

C. Equipment Data:

TAG NO.	PROCESS
LT-1	Wetwell Level

D. Installation Notes:
1. Install per manufacturer's instructions and in accordance with installation detail.
2. Provide and install a weighted stainless steel cable or chain or wall mounted stainless steel pipe on which the level sensor shall be mounted.

3. Level Sensor shall be mounted to the stainless steel cable, chain or pipe with stainless steel brackets and stainless steel U-bolts which are to be manufactured by the level sensor manufacturer.
4. All hardware shall be stainless steel including bracket anchors.

2.4 DOOR SWITCHES

A. General Specifications:
1. Square D heavy duty plunger type or Square D series SG magnetic proximity type with built in surge protection.
2. Dry contact closure output.

B. Equipment Data:

TAG NO.	PROCESS
NA	Valve Room
NA	Generator Room

C. Installation Notes:
1. Install per manufacturer's instructions.

2.5 MOTION SENSORS

A. General Specifications:
1. 120Vac to 24Vdc power supply
2. Dry contact closure output.
3. Wall/Ceiling mounting bracket.
4. Sentrol 6179-N/6084-N, Or Equal

B. Equipment Data:

TAG NO.	PROCESS
NA	Valve Room
NA	Generator Room

C. Installation Notes:
1. Install per manufacturer's instructions.

2.6 BUILDING LOW TEMP SWITCHES

A. General Specifications:
1. Hammond type SKT thermostat, 0-60 degree F.
2. Dry contact closure output.

B. Equipment Data:

TAG NO.	PROCESS
NA	Valve Room
NA	Generator Room

C. Installation Notes:
1. Install per manufacturer’s instructions.

2.7 FLOOD SWITCH

A. General Specifications:
1. The float switches shall be of the normally open SPST switch rated at 100VA.
2. The float switches shall be constructed entirely of 316 stainless steel, 2 inch diameter sphere permanently assembled to switch stem.
3. Switch to be specifically designed for corrosive service.
4. Mounting shall be 1/4" NPT.
5. 24" lead wires, 18 AWG
6. Acceptable Manufacturer: Omega LV-51, Or Approved Equal

B. Equipment Data:

TAG NO.	PROCESS
NA	Valve Room

C. Installation Notes:
1. All mounting hardware shall be stainless steel.
2. Install in NEMA 4X stainless steel box. In explosion hazard areas box shall be NEMA 4X and NEMA 7.
3. Install per manufacture's instructions.

2.8 MAGNETIC FLOW METER

A. General Specifications:
1. General
   a. 2 Year Warranty
   b. Specific design for waste water industry
   c. Operating Principle: Faraday's Law
   d. Excitation Type: bipolar pulsed DC
   e. System Accuracy: Plus or minus 0.2% of flow rate, or +/- 0.01% of full scale. Accuracy shall be verified by calibration of each flow meter in a flow laboratory traceable to the U.S. National Bureau of Standards.
   f. Each system shall be factory calibrated before shipment. No realignment shall be necessary.
   g. Operating Temperature -10 to +60 degrees C
   h. Power: 120 Volts AC, 60 Hz. (Provide with surge protection)
2. Primary Element – Meter:
   a. NEMA 4X Enclosure

b. Integral Earthing Grounding electrodes or provide grounding rings, orifices, and electrodes as necessary.
c. Flange Mounting.
d. At minimum, the primary element shall be approved for installation in Class I Division II, Group C through D Hazardous Location.
e. 316 Stainless Steel Electrodes
f. Teflon meter liner

3. Transmitter:
   a. NEMA 4X Enclosure
   b. Integral Mounting
   c. Micro-processor based, capable of bi-directional flow, field configurable without any external device.
   d. Integral Self Diagnostics
   e. Auto integrated zeroing.
   f. Local display shall indicate flow rate and total.
   g. Memory type: Non-volatile.
   h. The converter shall be provided with empty pipe detection system, which shall drive both the analog and digital output signals to zero when the electrodes are uncovered.
   i. Isolated powered 4-20 mA output.
   j. Pulsed Output for totalization.

B. Acceptable Manufacturer(s):
1. ABB Magmaster
2. Endress+Hauser
3. Foxboro
4. Rosemount

C. Equipment Data:

TAG NO.	PROCESS	SIZE
FE-1	Wastewater Flow	12”
FIT-1	Wastewater Flow	

D. Installation Notes:
1. Power to the magnetic flow meter shall be through the flow meter transmitter, which shall receive 120 volt AC power through a combination fused disconnect switch and surge protector.
2. Power to the magnetic flow meter shall be through the flow meter transmitter, which shall receive 120 volt AC power through a combination fused disconnect switch and surge protector.
3. Install grounding orifices and grounding system per manufacturer's instructions. Thermoweld grounding jumpers, such that continuous grounding path is achieved between the metal process piping and the grounding orifices.
4. The system shall be installed, wired, and calibrated in strict compliance with the manufacturer's instructions.

5. Calibrate each Flowmeter as follows:
6. Each system, including its complete instrument loop, shall be calibrated. All remote readings shall be equal to reading at the converter indicator and main control system displays.
7. Provide a written loop-calibration report for each flowmeter, which shall include, but shall not be limited to, the following:
8. Date and time the final calibration was complete.
9. Comparison of readings at the flowmeter with all other remote readings.
10. The names and signatures of personnel performing the calibration.

PART 3 EXECUTION

3.1 GENERAL

A. Install all field devices in accordance with manufacturer's instructions and as specified on attached forms.

B. Coordinate installation with General and Sub Contractors.

C. Instrument cable lengths shall be determined by the contractor before bid from estimating lengths required from the mechanical and electrical floor plans.

END OF SECTION

SECTION 15000

PLANT PIPING - GENERAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building piping.

B. Yard piping.

C. This Section provides general piping requirements. The Detail Piping Specifications provide additional requirements.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI B1.20.1-83 - Pipe Threads, General Purpose (In.).
2. ANSI B16.1-75 - Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.3-77 - Malleable Iron Threaded Fittings.
4. ANSI B16.4-77 - Cast Iron Threaded Fittings.
5. ANSI B16.5-81 - Pipe Flanges and Flanged Fittings.
6. ANSI B16.9-78 - Factory-Made Wrought Steel Buttwelding Fittings.
7. ANSI B16.12-83 - Cast Iron Threaded Drainage Fittings.
8. ANSI B16.14-77 - Ferrous Pipe Plugs, Bushings, and Lock Nuts with Pipe Threads.
9. ANSI B16.18-78 - Cast Copper Alloy Solder Joint Pressure Fittings.
10. ANSI B16.21-78 - Non-Metallic Flat Gaskets for Pipe Flanges.
11. ANSI B16.22-80 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
12. ANSI B16.39-77 - Malleable Iron Threaded Pipe Unions.
13. ANSI B31.1-83 - Power Piping.
14. ANSI B31.5-74 - Refrigeration Piping.

B. American Society for Testing and Materials (ASTM):
1. ASTM A47-77 - Specification for Malleable Iron Castings.
2. ASTM A53-82 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated and Seamless.
3. ASTM A74-82 - Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A106-82 - Specifications for Seamless Carbon Steel Pipe for High Temperature Service.
5. ASTM A120-82 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
6. ASTM A135-79 - Specifications for Electric Resistance Welded Steel Pipe.
7. ASTM A183-80 - Specifications for Carbon Steel Track Bolts and Nuts.
8. ASTM A234-82A - Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

9. ASTM A333-82 - Specification for Seamless and Welded Steel Pipe for Low Temperature Service.
10. ASTM B32-76 - Specification for Solder Metal.
11. ASTM B88-83 - Specification for Seamless Copper Water Tube.
12. ASTM B280-83 - Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
13. ASTM D2104-74 - Specification for Polyethylene (PE) Plastic Pipe, Schedule 40.
14. ASTM 2310-80 - Classification for Machine-Made Reinforced Thermosetting Resin Pipe.
15. ASTM D2564-80 - Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
16. ASTM D2609-74 - Specification for Plastic Inset Fittings for Polyethylene (PE) Plastic Pipe.
17. ASTM D2665-82 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
18. ASTM D2729-80 - Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
19. ASTM D2737-83 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Tubing.
20. ASTM D2740-80 - Specification for Poly (Vinyl Chloride) (PVC) Plastic Tubing
21. ASTM D3261-82 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Pipe and Tubing.
22. ASTM F402-80 - Practice for Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.

C. Cast Iron Soil Pipe Institute (CISPI):
1. CISPI 301-82 - Standard Specification for Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Systems for Drain Waste or Vent, Sewer, Rain Water or Storm Drain Systems.
2. CISPI 310-82 - Specification for Cast Iron Soil Pipe Institute's Patented Joint for Use in Connection with Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rain Water or Storm Drain Systems.
3. CISPI HSN-78 - Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe Fittings.

D. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code, Section II, Part C.
2. ASME Boiler and Pressure Vessel Code, Section IX.

1.3 PIPING SCHEDULE

A. The Piping Schedule in the Drawings lists each service by name and by legend, and tabulates the applicable Detail Piping Specification section numbers for each piping material to be used in a given service and location. In locations where the referenced specification for a service is unacceptable, due to unique or localized physical or chemical limitations, the specifications for an acceptable alternative material shall be submitted to the Engineer for approval.

B. The Detail Piping Specification section numbers are referenced also as to nominal pipe size, exposed or buried, submerged, concrete encased, test pressure, operating pressure, etc.

1.4 SUBMITTALS

A. Submit shop drawings under the provisions of Division 1. Submit pipe material and joint type for each pipeline.

B. Submit shop drawings under the provisions of Division 1 for all couplings, adapters, wall pipes, sleeves, sealants, dielectric fittings, hangers and supports.

C. Submit shop drawings under the provisions of Division 1 showing double-line drawings of each piping system, locating each support and hanger, identifying the type by catalog number or shop drawing detail number, and showing anchor locations and identifying them by shop drawing detail number. Show also all couplings, adapters, etc.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products under the provisions of Division 1.

PART 2 PRODUCTS

2.1 GENERAL

A. The materials to be used for the piping systems shown on the Drawings are listed by service in the Piping Schedule.

B. Like items of material shall be the end products of one manufacturer.

C. Paint and color code all exposed metal piping as specified in Section 09900, PAINTING and the Piping Schedule respectively. Label all exposed piping as specified herein.

D. No change in material or joint selection will be permitted after submittal of shop drawings and their final review by the Engineer.

2.2 PIPE JOINTS FOR EXPOSED PIPING

A. Provide flanged pipe joints on exposed piping 3-inches and larger except as shown otherwise. Grooved end pipe joints may be substituted for flange joints for piping 3 inches and larger except as noted otherwise.

B. Provide joints as specified in the Detail Piping Specifications for all pipe smaller than 3 inches.

C. Provide welded pipe joints where shown on the Drawings.

2.3 PIPE JOINTS FOR BURIED PIPING

A. Provide mechanical joint or push-on joint pipe ends on all buried ductile iron pipe.

B. Restrain by thrust blocks or by tie rods all elbows, tees, pipe plugs and valves or as specified in the Detail Piping Specifications.

C. Provide joints for other buried piping as specified in the Detail Piping Specifications.

2.4 BURIED PIPING EXPANSION PROVISION

A. Install buried piping to allow for thermal expansion due to differences between installation and operating temperatures.

2.5 BUILDING PIPING EXPANSION PROVISIONS

A. Provided flanged coupling adapters or bellows type flexible couplings at connections to equipment.

B. For Air Low Pressure (ALP) piping, provide Elastomer Bellows Expansion Joints as specified herein on as shown on the drawings.

C. Installation of additional flexible couplings to facilitate piping installation is acceptable provided that the Contractor submits complete details describing location, pipe supports, and hydraulic thrust protection.

D. Acceptable types of flexible couplings and expansion joints are as follows:
   1. Metallic Piping Systems:
      a. Flexible Couplings:
         1) Steel pipe: Provide Dresser Style 38; Smith-Blair, Inc. Style 411; or equal.
         2) Ductile iron pipe: Provide Dresser Style 53 or 153; Smith-Blair, Inc. style 441; or equal, with zinc-plated bolts and nuts.
         3) Provide thrust ties as required and shown to sustain the force developed by 1-1/2 times the test pressure specified.
      b. Transition Couplings: Provide Dresser Style 162; Smith-Blair, Inc. 413; or equal transition couplings to connect pipes with small differences in outside diameter.
      c. Flanged Coupling Adapters:
         1) Ductile iron pipe: provide Series 912 as manufactured by Smith-Blair, Inc.; or Style 127 for as manufactured by Dresser Industries, Inc.; or equal
         2) Steel pipe: provide Series 913 as manufactured by Smith-Blair, Inc.; or Style 127 for ductile iron piping and Style 128 for steel piping, as manufactured by Dresser Industries, Inc.; or equal.
         3) Provide thrust ties attached to the pipe with welding lugs or cast-in-place lugs where indicated. Anchor studs placed perpendicular to the longitudinal axis of the pipe are unacceptable.

4) Provide adequate thrust protection to sustain the force developed by 1-1/2 times the test pressures specified.

d. Bellows Type Flexible Couplings:

1) Provide Mercer Style 500; Garlock Style 204; or equal, with single Hypalon bellows and filled arch.

2) Provide flanged joints with steel retaining rings, rated for 125 psi maximum operating pressure and 180º F maximum operating temperature.

3) Provide thrust ties as required and shown to sustain the force developed by 1-1/2 times the test pressure specified.

e. Air Low Pressure (ALP) Elastomer Bellows Expansion Joint:

1) Provide Metraflex Style 711, or equal.

2) Type: provide reinforced, molded, non-filled wide arch type with 150-pound flanged ends, and split stainless steel flanged retaining rings.

3) Tube and cover materials: EPDM.

4) Min. rated lateral deflection, inch: 3/4.

5) Min. axial compression, inch: 1-3/4.

6) Min. working pressure, psig: 100.

7) Min. temperature rating, degrees F: 250.

2. Nonmetallic Piping Systems:

a. Flexible Couplings and Expansion Joints:

1) Provide Peabody Dore' Style E-1608-A; Resistoflex No. R6904; or equal.

2) Bellows: Teflon construction having two convolutions unless otherwise shown.

3) Joints: ductile iron flanges, drilled 150 psi ANSI standard, and Monel reinforcing bands suitable for 100 psi working pressure at 100º F and for the traverse shown on the Drawings.

4) Limit Bolts: provide as specified for adjacent piping and to sustain the force developed by 1-1/2 times the test pressures specified.

2.6 PIPING SUPPORT SYSTEMS

A. General:

1. Piping shall be supported, in general, as described here-in-after and as shown by the pipe support details on the Drawings. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Provide special support and hangers where standard catalog supports are inapplicable.

2. No attempt has been made to show pipe supports in most locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the plant. Where pipe supports are specifically called out on the Drawings, the Contractor shall provide this type of support.

3. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment.

4. Pipe support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus hydraulic thrust, and plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.
5. All buried and submerged piping supports, guides, anchor bolts, and fasteners, and those installed in wet wells, shall be Type 316 stainless steel.
6. Concrete anchors and anchor bolts shall be as specified in Section 05500.
7. All components of the piping support system shall be hot-dipped galvanized steel, except where stainless steel is specified.

B. Building Piping:
1. Horizontal piping shall be supported with adjustable swivel-ring, split-ring, or Clevis type hangers, Grinnell Figure 104 or 260; Fee & Mason Figure 199 or 239; or equal.
2. Stacked horizontal runs of piping along walls shall be supported by a metal framing system attached to concrete insert channels as shown, Unistrut, Kin-Line, or equal. No pipe shall be supported from the pipe above it.
3. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown, Grinnell Figure 264 or 259; Fee & Mason Figure 291 or 259; or equal.
4. Horizontal piping hanger support rods:
   a. Attach to steel beams with I-clamps, to concrete with inserts or flanges with flush shells, and to wood not less than 2-1/2-inch thick with lag screws and angle clips.
   b. Provide universal concrete inserts with a load rating greater than the hanger rods they support.
5. Vertical piping hangers and supports shall be channel and pipe straps manufactured by Unistrut, Kin-Line, or equal.
6. Piping supports for vertical piping passing through floor sleeves shall be hot-dipped galvanized steel riser clamps, Grinnell Figure 261; Fee & Mason Figure 241 or 238; or equal.
7. All hangers, rods, clamps, protective shields, metal framing supports, and hanger accessories shall be hot-dipped galvanized unless otherwise noted on the Drawings.

2.7 JOINTS FOR DISSIMILAR PIPE

A. Buried pipe: Make with insulating couplings, Dresser Style 39, Smith-Blair, Inc. Style 416, or equal.

B. Joints between dissimilar exposed pipe:
1. Make with insulating flanges, couplings and unions of suitable pressure ratings for system working pressures.
2. Construction materials: Galvanically compatible with the piping to which attached.
3. Joints:
   a. 2-inch and smaller: Screwed or solder-joint unions.
   b. 2-1/2-inch and larger: Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts as distributed by Epco Sales, Inc. of Cleveland, OH.; Capitol Insulation Unions; or equal. Insulating couplings shall be

Dresser Style 39; Smith-Blair, Inc. Style 416; or equal. Joints between dissimilar buried pipe shall be made with insulating couplings, Dresser Style 39, Smith-Blair, Inc. Style 416, or equal.

2.8 SERVICE SADDLES

A. Service Saddles For Ferrous Metal Piping: Pipe service saddles for all ferrous metal piping except stainless steel shall be Smith-Blair, Inc., Series 313 or 366; Dresser, Style 91; or equal. Service saddles shall be capable of withstanding 150 psi internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the saddle is installed. Taps shall have iron pipe threads. Saddles shall have malleable or ductile iron bodies and galvanized steel straps, steel hex nuts and washers, and neoprene seals. Service saddles shall be of double-strap design. Service saddles shall not be used on glass lined ductile iron pipe, factory applied tapping bosses shall be used.

B. Service Saddles For Plastic Pipe: Service saddles for PVC and CPVC pipe shall have solid polypropylene bodies with Buna-N seals and stainless steel worm drive clamps, or polypropylene threaded inserts with vinyl coated steel saddle bodies and Type 316 stainless steel bolts. Saddles shall be Smith-Blair, Inc., Style 315 or 317; Dresser, Style 194; or equal.

2.9 SLAB, FLOOR, WALL AND ROOF PENETRATIONS AND CLOSURES:

A. All piping penetrations of slabs, floors and walls shall be ductile iron wall pipes with integrally cast or fabricated welded seep rings unless shown otherwise on the Drawings. Verify size and location of all penetrations and place wall pipes before pouring concrete.

B. Ductile Iron Wall Pipes:
   1. Provide ductile iron wall pipes of the proper diameter and with joints as shown on the Drawings or as required for connection. Wall pipes shall be a thickness equal to or greater than the remainder of the pipe in the line, and shall comply with the requirements for fittings in the applicable Detail Piping Specification. All wall pipes shall be provided with integrally cast or fabricated welded seep rings. Flanges and mechanical joint bells set flush with the face of walls shall be tapped for stud bolts.
   2. Rubber-gasketed compression collars are unacceptable. The Contractor shall place early orders for wall pipes so they are available in sufficient time for placement in concrete forms. Coat wall pipes with System No. 2 as specified in Section 09900. Support wall pipes by formwork to prevent contact with reinforcing steel.

C. Pipe Sleeves:
   1. All piping passing through concrete or masonry shall be installed through hot-dipped galvanized steel pipe or Century-Line high density polyethylene sleeves as manufactured by PSI/Thunderline Corporation; or equal. For fire rated rooms, provide hot-dipped galvanized wall sleeves only. Fabricate sleeves as shown on the detail drawings.

2. All sleeves in exterior or water-bearing walls shall have a center flange for water stoppage. The annular space between pipes and sleeves in exterior walls shall be watertight.
3. The annular space between pipes and sleeves in exterior walls shall be watertight. The joint shall be sealed by a modular mechanical unit continuously fill the annular space between the pipe and wall sleeve. The interconnected rubber links shall be assembled with 316 stainless steel bolts, nuts, and washers pressure plates shall be glass reinforced nylon. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and wall sleeve opening. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings. Seals shall be Link-Seal as manufactured by PSI/Thunderline Corporation; or equal.
4. Fire rated pipe-through-wall penetrations shall be sealed be modular type interlocking synthetic rubber links shaped to continuously fill the annular space. Fire seals constructed of steel pressure plates and steel bolts, nuts, and washers and specially formulated fire resistant silicone rubber sealing elements (ASTM D2000 M1GE505). For 1 hour fire stop, use one belt of Link-Seal Model T (FM approved). For 3 hour fire stop, use 2 belts of Link-Seal Model FS. Seals shall be Link-Seal by PSI/Thunderline, or approved equal.
5. Coat steel pipe sleeves with System No. 2, as specified in Section 09900. Support sleeves from formwork to prevent contact with reinforcing steel.

2.10 FIRESTOPPING

A. For all pipes penetrating a fire rated room, provide hot-dipped galvanized wall sleeves and fill the void with Type II fire resistive caulk. Room fire rating is determined by the door type used, which is found in the Architectural Door Schedule.

B. Type II fire resistive caulk shall be 3M brand CP-25; or equal.

2.11 TAPE WRAP

A. Tape wrap shall be 15-mil butyl rubber adhesive, polyethylene-backed tape as manufactured by Polyken Division of the Kendall Company, Boston, MA; Royston Laboratories, Inc., Pittsburgh, PA; or equal.

2.12 HEAT SHRINK WRAP

A. Heat shrink wrap shall be a cross-linked polyolefin wrap or sleeve with a mastic sealant. Wrap or sleeves shall be Raychem WPC, TPS, flange seal, or equal. Wrap type shall be as recommended by the manufacturer for the specific joint.

2.13 METALLIC MARKING TAPE

A. Electrically conductive 2-inch width bright colored marking tape, designed for direct burial. Tape shall be detectable with standard pipeline detectors.

2.14 HEAT TRACING

A. Provide heat tracing as specified in Division 16.

2.15 PIPING SPECIALTIES

A. Stuffing Box Lubrication/Seal Water Piping: Provide the following seal water components for each pump, piped as shown in the Drawings: pressure regulator, Norgren Type 11-009, Casco Type D, or equal, pressure as determined by pump manufacturer; Y strainer, maximum 60 mesh (0.01 inch opening); needle disc type globe valve, V220 or equal; pressure gage with petcock, minimum 4-inch face, calibrated to read approximately mid-range at stuffing box pressure determined by pump manufacturer. Provide 1-foot lengths of 3/8-inch seal water hose with NPT fittings at each end. Seal water hose shall be Uniroyal clear plastic tubing rated 125 psig; or equal.

B. Simplex Strainer: Strainers, 3 inches and smaller, for water service shall be iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap. Screen shall be heavy-gauge stainless steel or monel, 30-mesh. Strainers shall be Crane No. 988-1/2; Mueller No. H-9330; or equal.

C. Simplex Strainers: Strainers, for chemical service, 1-1/2-inches and smaller, shall be Y-pattern, threaded, with PVC screen, 1/32-inch perforations. Strainer, for chemical service, 2 to 4-inches, shall be basket style, flanged, with PVC screen, 1/8-inch perforations. Strainer construction all polyvinyl chloride (PVC), Type 1, Grade 1, cell classification conforming to ASTM D-1784. Provide O-ring cover seals. Strainers rated 150 psi at 75 degrees F. Hayward Plastic Products, Inc.; or equal.

D. Flashing Sleeves: Flashing sleeves shall be installed wherever piping passes through concrete roof structures. Where piping passes through wood or metal deck roofs, provide a 4-pound lead flashing extending 8 inches from the pipe in all directions, extended up the pipe, and fitted with a double-threaded flashing for pipes 3 inches and smaller. Flashing shall turn down inside the pipe for 4-inch piping. Flashing sleeves shall be J. R. Smith Figure 1720; Josam No. 26400; or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Drawings do not attempt to show exact details of all piping, and no extra payment will be allowed for obstructions by work of other trades or local obstructions to the work under this Contract that require offsets. Where diagrams have been made to show piping connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities. Changes in location of equipment or piping, advisable in the opinion of the Contractor, shall be submitted to the Engineer for approval before proceeding with the work. All measurements and dimensions shall be verified at the site. All equipment shall be adjusted and left in a condition satisfactory to the Engineer.

3.2 PIPE PREPARATION AND HANDLING

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas patched in the field with

material similar to the original. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper handling of the pipe. Carefully handle pipe in such a manner as to avoid any damage to the pipe. Do not drop pipe into trenches under any circumstances.

3.3 PREPARATION OF TRENCH

A. Line and Grade:

1. Do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert, not at the top of the pipe, because of permissible variation in pipe wall thickness.
2. Grade shall be established from batter boards set in or over the trench at maximum 25-foot intervals. A minimum of three sets of batter boards with string line shall be maintained ahead of pipe laying at all times. A laser instrument may be used in place of batter boards.
3. Grade the bottom of the trench by hand to the line and grade to which the pipe is to be laid, with proper allowance for pipe thickness and for gravel bedding cushion when specified or indicated. Remove hard spots that would prevent a uniform thickness of bedding. Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

B. Bell (Joint) Holes: At the locations of each joint, dig bell (joint) holes of ample dimensions in the bottom of the trench and at the sides where necessary to permit easy visual inspection of the entire joint.

C. Removal of Water: Provide and maintain ample means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Remove water as specified in Division 1.

D. Prevent Water and Animals From Entering Pipe: When the pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed, and no water, animals, or foreign material shall be permitted to enter the pipe.

E. Pipe Cover: Minimum pipe cover shall be 6 feet unless otherwise indicated by Drawings or Detail Pipe Specifications.

F. Metallic Marking Tape: Provide over all buried non-metallic piping, minimum 6-inches below finished grade.

3.4 LAYING BURIED PIPE

A. All buried pipe shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Joints shall be made as specified for the respective types.

Take all precautions necessary to prevent uplift and floating of the pipe before backfilling. Pipe bedding, pipe zone, and trench backfill materials and workmanship shall be as specified in Division 2.

B. Provide all special tools, appliances and lubricants for jointing pipe. Joints shall be made in accordance with manufacturer's recommendations. Backfill adequately to assure that joints, once home, are held in place.

C. Provide concrete thrust blocks or galvanized steel thrust ties at all changes of direction, tees, pipe plugs and valves for buried piping with mechanical joints or push-on joints.

D. Where the pipe is connected to concrete structures, the connection shall be made as shown. If the connection is not shown, make connection such that a standard pipe joint or flexible coupling is located no more than 2 feet from the structure.

E. Connect dissimilar pipe materials by means of a flexible coupling specified under JOINTS FOR DISSIMILAR PIPE. Install couplings in strict accordance with the manufacturer's recommendations.

F. Use concrete closure collars only when approved by the Engineer, and only when standard rubber gasketed joints or flexible couplings are impractical. Before the closure collars are poured, wash the pipe to remove all loose material and soil from the surface on which the concrete will be placed. Wet concrete pipe thoroughly prior to pouring the collars. Wrap and securely fasten a light gauge of sheet metal or building felt around the pipe to insure that no concrete will enter the line. Place reinforcement as shown on the Drawings. Make entire collar in one pour using 3,000 psi concrete and extend a minimum of 12 inches on each side of the joint. The minimum thickness around the outside diameter of the pipe shall be 6 inches. No collar shall be poured in water. After the collars are poured and have taken their initial set, cure by covering with well-moistened earth.

3.5 INSTALLATION OF EXPOSED PIPING

A. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible.

B. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for steel and ductile iron pipe shall be as follows:

Pipe Size	Maximum Support Hanger Span	Minimum Rod Size Single Rod Hangers
1-inch and Smaller	6 feet	3/8-inch
1-1/4-inch thru 2-1/2-inch	8 feet	3/8-inch
3-inch and 4-inch	10 feet	12-inch
6-inch	12 feet	5/8-inch

Pipe Size	Maximum Support Hanger Span	Minimum Rod Size Single Rod Hangers
8-inch	12 feet	3/4-inch
10-inch and 12-inch	14 feet	7/8-inch
14-inch and 16-inch	16 feet	1-inch
18-inch	16 feet	1-1/8
20-inch thru 24-inch	18-feet	1-1/4
30-inch and larger	As Shown on Drawings	

1. When supporting ductile iron pipe, locate hanger rods at all non-rigid joints and at each change of direction.
2. Hanger minimum rod size for copper pipe shall be the same as for steel pipe. Hanger span shall be 2 feet less per size than for steel pipe, with 1-inch and smaller supported every 5 feet or less.
3. Hanger rod sizing for plastic pipe shall be same as for steel pipe. Spacing of hangers shall be as recommended by the manufacturer for the flow temperature in the pipe.
4. Hanger rod sizing and support spacing for stainless steel pipe shall be as shown in the Detail Piping Specification.
5. Vertical sway bracing shall be provided where shown, or on 10-foot maximum centers.
6. All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas or bridge crane runs.

C. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle the vertical centerline of pipes.

D. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings.

E. Plastic flanges shall be bolted using a filler gasket at any joint with a raised face. The filler gasket shall bear the bolt load uniformly and remove the flange moment from that part of the flange protruding beyond the outer edge of the raised face.

F. Piping shall be installed without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.

3.6 VENTS AND DRAINS

A. Vent the high point and drain the low point of all exposed pipelines, whether shown on the Drawings or not, with 3/4-inch valves on those pipelines 2-1/2-inch and larger and 1/2-inch valves on those pipelines 2-inch and smaller. Valve types shall be as shown on the Drawings. Where valves do not appear in the Schedule for a service listed, Type V300 valves shall be used.

3.7 WALL PIPES AND PIPE SLEEVES

A. Verify the size and location of all building and structure penetrations before concrete is poured. Wall pipes and pipe sleeves embedded in concrete walls, floors, and slabs shall be embedded as specified in Division 3 and as shown. Support all pipes embedded in concrete walls, floors, and slabs with formwork to prevent contact with the reinforcing steel.

3.8 INSTALLATION OF FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS, GROOVED JOINT COUPLINGS, AND SERVICE SADDLES

A. Before installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Workmen tightening bolts shall use torque-limiting wrenches.

3.9 INSTALLATION OF INSULATING FLANGES, COUPLINGS AND UNIONS

A. Install insulating flanges, couplings, or unions wherever copper and ferrous metal piping are connected, wherever dissimilar ferrous metal are connected, wherever submerged metallic piping is connected to unsubmerged piping, and where shown on the Drawings. Insulated joints connecting submerged piping to exposed piping shall be installed above maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged metallic piping shall be isolated from the concrete reinforcement.

3.10 TESTING

A. General: Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Engineer will monitor the tests. Test pressures and fluid medium shall be as specified in the Piping Schedule on the drawings.

B. Testing New Pipe That Connects To Existing Pipe: New pipelines that are to be connected to existing pipelines shall be tested by isolating the new pipe.

C. Buried Piping:

1. Conduct final acceptance tests on buried piping that is to be hydrostatically tested after the trench has been completely backfilled. The Contractor may, if field conditions permit, as determined by the Engineer, partially backfill the trench and leave the joints open for inspection and conduct an initial service leak test. The acceptance test shall not, however, be conducted until all backfilling has been completed.
2. Buried piping that is to be pneumatically tested or subjected only to an initial service leak test shall have all joints exposed for the acceptance test.

D. Exposed Piping:
1. Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors.

E. Hydrostatic Leak Tests:
1. Equipment - Furnish the following equipment for the hydrostatic tests:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump Suitable hose and suction pipe as required

2. Exposed Piping - Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be clean and shall be of such quality as to minimize corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The hydrostatic test pressure shall be continuously maintained for a minimum time of 30 minutes and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Correct any visible leakage.
3. Buried Piping:
   a. Some leakage is permissible from buried water and wastewater pressure lines. Consequently, the hydrostatic testing of these pipelines must be conducted in a different manner, as follows:
   b. Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 days have elapsed after the thrust blocking is installed. If high-early cement is used for thrust blocking, the time may be reduced to 2 days. When testing cement-mortar lined piping, slowly fill the section of pipe to be tested with water and allow to stand for 24 hours under slight pressure to allow the cement-mortar lining to absorb water.

c. Expel all air from the piping system before testing and apply and maintain the specified test pressure by means of the hydraulic force pump. Valve off the piping system when the test pressure is reached and conduct the pressure test for 2 hours, reopening the isolation valve only as necessary to restore the test pressure. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately. This measurement represents the leakage, which is defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L \equiv \frac{ND(P)^{1/2}}{7400}$$

In the above formula:

L = allowable leakage, in gallons per hour.
N = number of joints in the length of pipe tested.
D = nominal diameter of pipe, in inches.
P = average test pressure during the leakage test, in pounds per square inch

d. Correct any leakage greater than the allowance determined under this formula.

F. Pneumatic Leak Tests:

1. Equipment - Furnish the following equipment for the pneumatic tests:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure.
1	Calibrated test gauge.

2. Pneumatic testing shall be performed using accurately calibrated instruments and oil-free, dry air. Tests shall be performed only on exposed piping, but only after the piping has been completely installed, including all supports, hangers and anchors, and inspected for proper installation. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule. The Contractor shall recognize the hazards associated with air testing and shall take all necessary precautions to protect test personnel and Owner's personnel. All piping to be ested shall be secured to prevent damage to adjacent piping and

equipment in the event of a joint failure. Any appurtenant instruments or devices that could be damaged by the test shall be removed from the piping or suitably isolated before applying the test. Before starting the test, the Contractor shall notify the Engineer.

3. A preliminary pneumatic test not to exceed 25 psig shall be applied to the piping system before final leak testing, as a means of locating major leaks. Examination for leakage, detected by soap bubbles, shall be made at all joints and connections. After all visible leaks have been corrected, the pressure in the system shall gradually be increased to not more than 1/2 of the test pressure, after which the pressure shall be increased in steps of approximately 1/10 of the test pressure until the required test pressure has been reached. The pneumatic test pressure shall be continuously maintained for a minimum time of 10 minutes and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage. Any visible leakage shall be corrected.

G. Initial Service Leak Tests:

1. Equipment: Equipment used for initial service leak testing may be the same as that specified under HYDROSTATIC and PNEUMATIC LEAK TESTS hereinbefore, or the pump or compressor connected to the piping system.
2. Procedure: The initial service leak test shall be performed by gradually bringing the piping system up to normal operating pressure and holding it at the normal operating pressure continuously for a minimum of 10 minutes. Examination for leakage shall be made at all joints and connections. Soap bubbles shall be used to detect leaks in pneumatically tested systems. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected.

H. Test Records: Records shall be made of each piping system installation during the test. These records shall include:

1. Date of test.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
6. Certification by Contractor and initialed acknowledgment by Engineer.

3.11 INTERIM CLEANING

A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filing, gravel, cleaning rags, etc. within piping sections. All piping shall be examined to assure removal of these and other foreign objects before assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.12 FINAL CLEANING

A. Following assembly and testing and before final acceptance, all pipelines installed under this section, except air lines and gas lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2-inch and larger or by dropping spools and valves. Immediately following drainage of flushed lines, the piping shall be air dried with compressed air.

B. Air and gas piping shall be blown clean of loose debris with compressed air.

3.13 CORROSION PROTECTION OF ATMOSPHERIC EXPOSED PIPING ACCESSORIES

A. All atmospheric exposed surfaces of black and hot-dip galvanized steel, brass, copper and bronze piping components shall be painted in accordance with Section 09900, System No. 5 or System No. 6 as described in the Paint Application Schedule.

B. Pipe support systems, except galvanized or stainless steel components, shall be painted in accordance with Section 09900, System No. 5.

3.14 CORROSION PROTECTION FOR CARBON STEEL PIPE

A. Exterior Coating For Exposed, Steel Pipe, Including Galvanized Pipe: Shop prime and finish coats in accordance with Section 09900, System No. 5 or System No. 6 as required. For insulated piping, paint shall be applied before installation of insulation.

B. Interior Lining: Carbon steel piping that is to be lined with coal-tar epoxy, as noted in the Piping Schedule shown on the Drawings, shall be as specified in Section 09900, System No. 2. Carbon steel piping that is to be cement-lined as noted on the Piping Schedule shall be in accordance with AWWA C205. Lining shall be applied by the pipe supplier.

C. Exterior Protection For Buried, Submerged or Embedded Pipe and for all Hydrants:
   1. Buried steel shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC-SP 1, and wire brushed, SSPC-SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape manufacturer's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall be tape wrapped or heat shrink-wrapped. Joints shall be completed above grade or a sufficient size bell hole excavated to permit joint wrapping without contamination. Tape wrapping and heat shrink-wrap are specified under PRODUCTS.

D. Exterior Protection for Buried or Submerged Piping Accessories: Exterior protection shall be in accordance with Section 09900, System No. 2.

3.15 CORROSION PROTECTION FOR COPPER PIPING

A. For Atmospheric Exposed Copper Pipe: Copper piping shall be painted in accordance with Section 09900, System No. 5 or System No. 6. Paint shall be applied before installation of insulation.

B. Exterior Coating For Buried Copper Pipe: All buried copper pipe shall be coated by hand taping with pipe tape. The pipe surface shall be solvent cleaned, SSPC-SP 1, and wire brushed, SSPC-SP 3, to remove all dirt and loose rust and mill scale, and immediately primed with the tape manufacturer's recommended primer in accordance with the manufacturer's recommendations. The tape shall be spirally applied to the pipe with a 50 percent overlap minimum after the primer has thoroughly dried. Joints shall be completed above grade or a sufficient size bell hole excavated to permit joint wrapping without contamination. Tape wrapping and heat shrink-wrap are specified under PRODUCTS.

3.16 CORROSION PROTECTION FOR DUCTILE IRON AND CAST IRON SOIL PIPE

A. For Atmospherically Exposed Ductile Iron: Exterior protection shall be in accordance with Section 09900, System No. 5 or System No. 6 as described in the Paint Application Schedule. NOTE: Ductile iron pipe for interior use shall be provided by the Mechanical Contractor without asphaltic or bitumastic exterior coatings. This requirement applies to all ductile iron pipe except buried pipe.

B. Cement Linings: As specified in the Detail Piping Specification.

C. Exterior Protection For Buried Pipe: Buried ductile iron piping shall be wrapped with polyethylene bagging, 8 mils minimum thickness, manufactured in accordance with the latest edition of ASTM D 1248, Type I, Class C, Grade E1 and installed in accordance with ANSI A21.5/AWWA C105 and the manufacturer's recommendations.

3.17 PIPE PAINTING AND IDENTIFICATION

A. Painting of piping systems shall be as specified in Section 09900, and in accordance with the Piping Schedule.

B. Mechanical pipe identification shall be as specified in Section 15190.

END OF SECTION

SECTION 15004

DETAIL PIPING SPECIFICATION - CEMENT-LINED
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cement-lined ductile iron pipe.

B. Grey cast iron or ductile iron fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General.
   1. See referenced section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

PART 2 PRODUCTS

2.1 PIPE

A. General Pipe Requirements: Centrifugally cast, Grade 60-42-10 iron, ANSI/AWWA C151/A21.51, cement-lined and seal-coated in accordance with ANSI/AWWA C104/A21.4, 250 psi minimum working pressure.

B. Buried pipe Requirements: Minimum thickness Class 53 as specified in ANSI/AWWA C151/A21.51, Tables 51.4 and 51.5.

C. Requirements for specific types of pipes:
   1. Exposed Flanged Pipe: Minimum thickness class 53 as specified in ANSI/AWWA C115/A21.15, Table 15.1.
   2. Grooved End Pipe 3-inches and larger:
      a. Conform to AWWA C606 rigid radius cut grooved pipe on all exposed piping unless otherwise noted.
      b. Conform to AWWA C606 for all flexible radius cut grooved pipe as noted.
      c. Conform to the following minimum Thicknesses Classes:
         1) 3 to 16 inch piping: Class 53.
         2) 18 inch piping: Class 54.
         3) 20 inch piping: Class 55.
         4) 24 inch piping and larger: Class 56.
   3. Mechanical Pipe: Conforming to the requirements of ANSI/AWWA C111/A21.11.

4. Push-On: Conforming the requirements of ANSI/AWWA C111/A21.11.

2.2 JOINTS

A. Flanged, grooved end, mechanical joint, or push-on as specified in Section 15000.

B. Refer to the pipe schedule in the Drawings for specific joint type required for some services.

C. Provide fittings and all coupling components from the same manufacturer to assure uniformity and compatibility of grooved end piping components.

D. Provide joint restraint as follows:
1. At all elbows (except 90° elbows) and all joints within 20 feet of all elbows.
2. At all 90° elbows and all joints within 40 feet of all 90° elbows.

E. Accomplish joint restraint by using push-on joint restraint gaskets from American Ductile Iron Pipe Fast-Grip gasket of U.S. Pipe Field Lok gasket, or equal, or mechanical joints with multiple wedge retainer glands, EBAA Iron Sales MEG-A-LUG series 1100, or approved equal.

2.3 FITTINGS

A. General Construction: Gray or ductile iron, 150 psi minimum working pressure, cement-lined and seal-coated.

B. Provide tapping bosses on fittings where taps are shown.

C. Requirements for specific types of fittings:
1. Flanged: ANSI/AWWA C110/A21.10 and ANSI B16.1, faced and drilled 125-pound ANSI standard.
2. Grooved End: ANSI/AWWA C110/A21.10, ANSI/AWWA C606, and ANSI B16.1, radius cut grooved, rigid joint, as manufactured by Victaulic, Gustin-Bacon, or equal.
3. Mechanical Joint: Full body mechanical joint fittings meeting ANSI/AWWA C110/A21.10 with the joint meeting the requirements of ANSI/AWWA C111/A21.11.
4. Push-On: ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53, American Ductile Iron Pipe, Fastite Joint; or U.S. Pipe and Foundry, Tyton Joint, or equal.

D. Compact ductile iron mechanical joint fittings, ANSI/AWWA C153/A21.53, Clow Corporation or equal, may be substituted for the mechanical joint fittings specified above.

2.4 FLANGES

A. ANSI A21.15/AWWA C115, thread on flanges with 250 psi working pressure and ANSI 125-pound drilling.

B. Grooved end pipe adaptor flanges shall be malleable iron, ASTM A 47, or ductile iron, ASTM A 536, Victaulic Style 31, Gustin-Bacon, or equal.

2.5 COUPLINGS

A. Grooved end pipe couplings shall be malleable iron, ASTM A47, or ductile iron, ASTM A536, Victaulic Style 31, Gustin-Bacon, or equal.

2.6 BOLTS & NUTS

A. Flanged: Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts. Size, length, and number as shown in AWWA C110 and AWWA C115.

B. Mechanical Joint: In accordance with ANSI/AWWA C111/A21.11 in stainless steel 304, T-bolts per ASTM F593 and heavy hex nuts per ASTM F594

Note that standard material is HSLA steel, can have an optional coating fluropolymer coating material which is VOC-compliant, resin-bonded, thermally cured and dry lubricant. The t-bolts and nuts are also available in stainless steel 304 & 316, t-bolts per ASTM F593 and heavy hex nuts per ASTM F594.

C. Grooved End: Manufacturer's standard.

2.7 GASKETS

A. Mechanical or Push-on Joints: Natural rubber (styrene butadiene copolymer) conforming to ANSI/AWWA C111/ A21.11.

B. Flanged Joints:
1. Provide 1/8-inch thick, cloth-inserted natural rubber (styrene butadiene copolymer) conforming to applicable parts of ANSI B16.21 and AWWA C207.
2. Gasket material: Suitable for use in sewage or potable waterlines and free from corrosive alkali or acid ingredients.
3. Gasket type:
   a. Full-face type for 125-pound FF flanges and 250-pound FF flanges up to 12-inches in diameter.
   b. For sizes 14-inches and greater, use ring gaskets.

C. Grooved End Joints:
1. Provide manufacturer's flush-seal type specifically designed for cast surfaces.
2. Properties: As designated in ASTM D 2000 for the required service.
3. Dimensions: Conforming to AWWA C 606.

2.8 LUBRICANT

A. Provide manufacturer's standard lubricant for push-on or mechanical joint piping.

PART 3 EXECUTION

3.1 HANDLING PIPE

A. Care shall be taken not to damage the cement lining when handling the pipe.

3.2 CUTTING PIPE

A. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.

3.3 DRESSING CUT ENDS

A. Dress cut ends of pipe in accordance with the type of joint to be made.

B. Dress cut ends of mechanical joint pipe to remove sharp edges or projections which may damage the rubber gasket.

C. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer.

D. Dress cut ends of pipe for flexible couplings, flanged coupling adapters, and grooved end pipe couplings as recommended by the coupling or adaptor manufacturer.

3.4 FABRICATION OF FLANGED PIPE

A. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

B. Flanges shall be faced after fabrication in accordance with ANSI A21.15/AWWA C115.

3.5 JOINTING PIPE

A. Flanged:
1. Thoroughly clean all oil, grease, and foreign material from the faces of the flanges before connecting flanged pipe.
2. Check all rubber gaskets for proper fit and cleanliness.
3. Take care to assure proper seating of the flange gasket.
4. Tighten bolts so that the pressure on the gasket is uniform.
5. Use torque-limiting wrenches to ensure uniform bearing insofar as possible.
6. Removed and reset gasket and retighten bolts at joints that leak during retightening.

B. Grooved end:
1. Install in accordance with the manufacturers printed instructions.
2. Clean ends, coupling, and gasket before assembly.

C. Mechanical and Push-On Joint:

1. Join pipe with mechanical or push-on type joints in accordance with the manufacturer's recommendations.
2. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation.
3. Furnished pipe manufacturer's gasket lubricant. No substitute lubricants will be permitted.
4. Install mechanical joints in accordance with the instructions in ANSI/AWWA C600 and ANSI/AWWA C111/A21.11.

3.6 TESTING

A. All lines shall be tested as listed in the Pipe Schedule shown on the Drawings.

B. Follow the testing procedures specified in Section 15000.

3.7 CORROSION PROTECTION

A. As specified in Section 15000.

3.8 SUPPORTS AND HANGERS

A. As specified in Section 15000.

3.9 GENERAL INSTALLATION OF EXPOSED PIPING

A. As specified in Section 15000.

END OF SECTION

SECTION 15008

DETAIL PIPING SPECIFICATION - MILL TYPE
STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mill type steel pipe and malleable iron fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General:

B. See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

B. Welding procedures and qualifications.

C. Submit a list of the welders he proposes using and the type of welding for which each has been qualified.

D. Submit review procedure specifications and qualifications records of welding procedures for all pipe welding to be performed under this section, in accordance with Section IX, Article II of the ASME Boiler and Pressure Vessel Code.

PART 2 PRODUCTS

2.1 PIPE

A. General Pipe Requirements:
1. Piping 1½-inch and smaller: ASTM A 106, Grade B.
2. Piping 2-inch and larger: Carbon steel, black, seamless or electric resistance welded, ASTM A 53, Grade B.

B. Screwed, Butt-Welded, and Flanged Pipe:
1. 2-inch and Smaller: Schedule 40.
2. 2-1/2-inch through 6-inch: Schedule 40.
3. 8-inch through 12-inch: Schedule 20.
4. 14-inch through 24-inch: Schedule 10.

C. Grooved End Pipe:
1. 2-1/2-inch through 6-inch: Schedule 40.
2. 8-inch through 14-inch: Schedule 30.

2.2 JOINTS

A. Requirements for Specific Types of Joints:
   1. 2-inch and Smaller: Screwed.
   2. 2½-inch to 14-inch: Grooved end conforming to AWWA C606, Butt-welded, or flanged, unless other- wise shown.
   3. Larger than 14-inch: Butt-welded or flanged unless otherwise shown.
   4. Do not use grooved end joints for natural gas (G) or low pressure air piping (ALP).

B. Refer to the pipe schedule in the Drawings for specific joint type required for some services.

2.3 FITTINGS

A. 2-Inch and Smaller:
   1. General requirements: Screwed, 150-pound malleable iron, black, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.
   2. Standard union requirements: 300-pound malleable iron, black, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3, brass to iron seat.
   3. Unions for natural gas: 3,000 pound, forged carbon steel, ASTM A105, steel seats.

B. 2½-Inch Through 14-Inch:
   1. Grooved End: Malleable iron, ASTM A47, or ductile iron, ASTM A536, grooved or shouldered ends to accept mechanical couplings without field preparation, Victaulic, Gustin-Bacon, or equal.
   2. Butt Welding Type: Carbon steel, to match pipe wall thickness, ASTM A234, Grade WPB, conforming to ANSI B16.9 standards.

C. Larger than 14-inch: Butt-welded carbon steel, to match pipe wall thickness, ASTM A 234, Grade WPB, conforming to ANSI B16.9 standards.

2.4 BRANCH CONNECTIONS

A. 2-Inch and Smaller: Screwed tees as specified under FITTINGS, or 3000-pound WOG forged carbon steel, ASTM A105, Grade II commercial welding branch fittings with threaded outlet, as manufactured by Bonney Forge Division, Gulf and Western Industrial Products Company, Allentown, PA; Allied Piping Products Co., Inc., Norristown, PA; or equal.

B. 2½-Inch and Larger: Tees or reducing tees as specified under FITTINGS; to match pipe wall, cast steel, ASTM A216, Grade WCA, or 3000-pound WOG forged carbon steel, ASTM A105, Grade II commercial welding branch fittings with butt-welding outlet, as manufactured by Bonney Forge Division, Gulf and Western Industrial Products Company, Allentown, PA; Allied Piping Products Co., Inc., Norristown, PA; or equal; or fabricate from pipe. Use tee for branch outlet full size of run or one size reduced.

2.5 FLANGES

A. Forged steel, ASTM A 181 Grade I, slip-on or welding neck type, faced and drilled 150-pound, 1/16-inch raised face, ANSI B16.5 standard, or AWWA C207, Class D hub type, faced and drilled 125-pound flat-face, ANSI B16.1 standard.

B. Grooved End Pipe Adapter Flanges: Provide malleable iron, ASTM A47, conforming to Federal Specification QQ-I-666C, Grade II, or ductile iron, ASTM A536, Victaulic, Gustin-Bacon, or equal. When matching equipment with 250-lb or 300-lb RF flanges, use forged steel, ASTM A181, Grade I welding neck type, faced and drilled 300-lb, 1/16-inch raised face ANSI Standard.

C. Use welding neck flanges when abutting butt-weld fittings. Match Welding neck bore pipe ID.

D. Machine off the raised face of a steel flange when mating with a cast iron flat faced flange.

2.6 COUPLINGS

A. Grooved end pipe couplings shall be malleable iron, ASTM A 47, conforming to Federal Specification QQ-I-666C, Grade II, or ductile iron, ASTM A 536, Victaulic Style 75, Gustin-Bacon, or equal.

B. Screwed pipe couplings shall be malleable iron, ASTM A 197 or ASTM A 47, dimensions conforming to ANSI B16.3. Couplings for use on natural gas, propane, nitrogen, fuel oil or lubricating grease shall be 3000-pound, forged carbon steel, ASTM A 105.

2.7 BOLTING

A. For Grooved End Joints: Heat-treated carbon steel, ASTM A183 bolts and nuts, minimum tensile 110,000 psi.

B. 150-pound RF Flanges: Carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

C. 125-pound FF AWWA Flanges: Carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.

D. When mating flange on equipment is cast iron and gasket is flat ring type, use ASTM A307, Grade B, square head bolts and heavy hex head nuts.

E. When 1/8-inch undersize bolting material is used for steel insulating flanges, use ASTM A193, Grade B7 alloy stud bolts and ASTM A194, Grade 2H carbon steel heavy hex nuts.

2.8 GASKETS

A. For Grooved End Joints: EPDM or Chlorinated butyl with properties conforming to ASTM D 2000, dimensions to AWWA C606.

B. For Flanged Joints:
1. Unless otherwise specified, 1/16-inch flat ring type, Garlock 2900, or equal.
2. Gaskets for digester and natural gas service shall be 1/8-inch thick neoprene rubber, durometer hardness No. 80, 1,500 psi minimum tensile strength, 125 percent minimum elongation, flat ring type with RF flanges and full face type with FF flanges, Garlock Style 7797, or equal.

2.9 THREAD LUBRICANT

A. Teflon tape.

2.10 COVERED WELDING ELECTRODES

A. AWS A5.1, E6010 for shielded metal-arc process.

2.11 WELDING ROD AND BAR ELECTRODES

A. As specified in PROCEDURE QUALIFICATIONS.

PART 3 EXECUTION

3.1 WELDING

A. In accordance with latest editions of Section IX, ASME Boiler and Pressure Vessel Code and the American national Standard Code for Pressure Piping, ANSI B31.3.WELDING PERFORMANCE QUALIFICATION

B. Qualify all welders and welding operators at the Contractor's sole expense by a qualified testing laboratory before performing any welding under this section.

C. Qualification tests: Perform qualification tests in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

D. Qualify welders and operators for making groove welds in carbon steel pipe in positions 6G for each welding process to be used.

E. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer.

F. Retest any welders at any time Engineer considers the quality of the welder's work substandard.

3.2 FABRICATION

A. End Preparation:
   1. Prepared Pipe edges preferably by machine shaping.
   2. Oxygen or arc cutting are acceptable only if the cut is reasonably smooth and true and all slag is removed either by chipping or grinding.
   3. Bevel ends for butt welding to conform to ANSI B16.25.

B. Cleaning: Surfaces shall be clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.

C. Alignment and Spacing: Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness. Root opening of the joint shall be as stated in the procedure specification.

D. Procedure:
   1. Field welding: Use the shielded metal-arc process.
   2. Shop fabrication: Fabricate in accordance with the submitted welding procedure qualifications.
   3. Perform no welding if there is impingement of any rain, snow, sleet, or high wind on the weld area or if the ambient temperature is below 32° F.
   4. If the ambient temperature is less than 32° F preheat the work to a temperature that is warm to the touch of a hand.
   5. Tack welds:
      a. Perform tack welds by a qualified welder using the same procedure as for the completed weld.
      b. Completely removed tack welds that have cracked or do not match the requirements of the completed weld.
      c. Make tack welds that are not to be removed with an electrode that is the same as or equivalent to the electrode to be used for the first weld pass.
   6. Thoroughly clean each layer of deposited weld metal before the deposition of each additional layer of weld metal, including the final pass, with a power-driven wire brush.
   7. Chip or grind out surface defects that will affect the soundness of weld.
   8. On pipe sizes 6-inch through 24-inch, make a minimum of three weld passes using the specified covered electrode.
   9. On all welded pipe 4-inch and under, make a minimum of a full root and second pass weld.
   10. Finished welds: Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of the limits prescribed in Chapter V of ANSI B31.3.
   11. Branch connections: Fit and groove-welded in accordance with the details described and shown in Chapter V of ANSI B31.3.

3.3 TESTING

A. Hydrostatically or pneumatically test all lines at the pressures listed in the Piping Schedule.

B. Follow procedures as specified in Section 15000.

3.4 SUPPORTS AND HANGERS

A. As specified in Section 15000.

3.5 CORROSION PROTECTION

A. As specified in Section 15000.

3.6 GENERAL INSTALLATION OF EXPOSED PIPING

A. As specified in Section 15000.

END OF SECTION

SECTION 15018

DETAIL PIPING SPECIFICATION – COPPER AND COPPER ALLOY PIPE, TUBING AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Copper and copper alloy pipe, tubing and fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General:
   1. See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

PART 2 PRODUCTS

2.1 MATERIALS

A. Tubing: Copper, seamless, ASTM B 88, type and temper as follows:
   1. Potable Water, Exposed: Type L, hard drawn.
   2. Potable Water, Buried: Type K, soft temper.
   3. Non-Potable Water, Buried: Type K, soft temper.
   4. Domestic Hot Water: Type L, hard drawn.

B. Fittings: Commercially pure wrought copper, socket joint, ASTM B 75, dimensions conforming to ANSI B16.22.

C. Solder: 95-5 wire solder (95 percent tin, 5 percent antimony), ASTM B 32, Grade 95 TA. Do not use cored solder.

PART 3 EXECUTION

3.1 GENERAL

A. Piping fabrication and installation shall conform to the requirements of Chapter V of ANSI B31.3. Pipe, trays, and tubing shall be installed parallel with, or at right angles to, the structural members of buildings; vertical runs shall be straight and plumb. Tubing bends shall be tool-formed without flattening, and shall be all of the same radius to ensure good appearance. Care shall be taken to keep tubing runs away from hot pipes, and under no circumstances shall they be less than 12 inches from any such pipe. Individual pipe, tubing runs, and instrument capillary tubing shall be continuously

supported in channels, trays, or from structures so that mechanical damage will not occur, and shall be clipped in place. Tubing trays and channels shall be located in such a manner that they will not catch spillage, overflow, or dirt from above.

B. Cut tubing square and remove burrs. Clean both inside of fittings and outside of tubing with steel wool and muriatic acid before sweating. Take care to prevent annealing of fittings and hard-drawn tubing when making connections.

C. Bends in soft temper tubing shall be long sweep, wherever possible. Bends shall be shaped with bending tools and shall be made without appreciable flattening, buckling, or thinning of the tube wall at any point.

3.2 BRAZING QUALIFICATIONS

A. The qualifications of brazing procedures, brazers, and brazing operators shall be in accordance with the requirements of Articles XII and XIII, Section IX, ASME Boiler and Pressure Vessel Code.

3.3 TESTING

A. All lines shall be hydrostatically or pneumatically tested at the pressures listed in the Piping Schedule. Test procedures shall be as specified in Section 15000.

3.4 SUPPORTS AND HANGERS

A. As specified in Section 15000.

3.5 CORROSION PROTECTION

A. As specified in Section 15000.

END OF SECTION

SECTION 15020

DETAIL PIPING SPECIFICATION – POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinyl chloride (PVC) pipe and fittings.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General:
   1. See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

PART 2 PRODUCTS

2.1 PIPE

A. Less than 4-inches:
   1. PVC, Schedule 80, Class 12454-B, (Type I, Grade 1), conforming to ASTM D 1784 and ASTM D 1785.

B. 4-inch and larger:
   1. PVC, Schedule 40, Class 12454-B, (Type I, Grade 1), conforming to ASTM D 1785 and ASTM D 2466.

2.2 NIPPLES

A. Same as pipe, except threaded nipples shall be Schedule 80.

2.3 JOINTS

A. Socket-weld, except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly.

2.4 FITTINGS

A. Schedule 80, as specified under PIPE. Fittings shall conform to the requirements of ASTM D 2467 for socket type and ASTM D 2464 for threaded type.

2.5 FLANGES

A. One-piece, molded hub type flat-faced flanges, 125-pound standard.

2.6 GASKETS

A. Full-faced, 1/8-inch thick, fabricated from ethylene propylene rubber (EPR).

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect PVC flange from bolting moment.

2.7 BOLTING

A. Bolts shall be fabricated in accordance with ANSI B18.2 and provided with washers of the same material as the bolts.

B. With Flat Ring Gaskets: Carbon steel, ASTM A 307, Grade B square head bolts & ASTM A 563, Grade A heavy hex head nuts

C. With Full Face Gaskets or in Corrosive Areas or Outside Locations: Type 316 stainless steel, ASTM A 193, Grade B8M hex head bolts and ASTM A 194, Grade 8M hex head nuts.

2.8 SOLVENT CEMENT

A. All socket connections shall be joined with primer and PVC solvent cement conforming to ASTM D 2564. Manufacture and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility.

2.9 THREAD LUBRICANT

A. Teflon tape.

PART 3 EXECUTION

3.1 GENERAL

A. All rigid PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Buried plastic pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and during operation.

B. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to over-tighten these fittings. Pipe shall not be laid when the temperature is below 40º F, nor above 90º F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight before and during the laying operation.

C. Provide adequate ventilation when working with pipe joint solvent cement.

3.2 TESTING

A. All lines shall be hydrostatically tested at the pressures listed in the Piping Schedule. Test procedures shall be as specified in Section 15000.

3.3 SUPPORTS AND HANGERS

A. Supports and hangers shall be as specified in Section 15000, except spacing shall be in accordance with the pipe manufacturer's recommendations.

END OF SECTION

SECTION 15030

DETAIL PIPING SPECIFICATION –
BUILDING DRAINAGE SYSTEMS (GRAVITY)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Building gravity drainage systems.

1.2 RELATED SECTION

A. Section 15000 - Plant Piping - General:

B. See referenced Section for additional requirements.

1.3 SUBMITTALS

A. As specified in Section 15000.

1.4 GENERAL

A. Building drainage systems are categorized as follows:
1. Sanitary and Waste Drains: Drains from building floor drains, and other building process drains, other than acid-resistant drains, extending to 5 feet beyond the building line.

PART 2 PRODUCTS

2.1 SANITARY AND WASTE DRAINS AND VENTS, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D2729.
1. Fittings: PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

B. Cast Iron Pipe: ASTM A74, service weight.
1. Fittings: Cast iron.
2. Joints: CISPI HSN compression type with ASTM C564 neoprene gaskets.

2.2 SANITARY AND WASTE DRAINS AND VENTS, ABOVE GRADE.

A. PVC Pipe: ASTM D2729.
1. Fittings: PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

B. Cast Iron Pipe: ASTM A74, service weight.
1. Fittings: Cast iron.

2. Joints: ASTM C564, neoprene gasket system.

2.3 FLASHING SLEEVES

A. Flashing sleeves shall be installed wherever piping passes through concrete structures. Where piping passes through wood or metal deck roofs, provide a 4-pound lead flashing extending 8 inches from the pipe in all directions, extended up the pipe, and fitted with a double-threaded flashing for pipes 3 inches and smaller. Flashing shall turn down inside the pipe for 4-inch piping. Flashing sleeves shall be J. R. Smith Figure 1720, Josam No. 26400, or equal.

PART 3 WORKMANSHIP

3.1 GENERAL

A. Install all piping and accessories in accordance with the plumbing laws, rules, and regulations of the State and of the City, whichever represents the higher standard. All work shall be approved by the State and City Plumbing Inspector.

3.2 SANITARY AND WASTE DRAIN AND VENT PIPING

A. Set sanitary and waste drain and vent piping occurring above the floor slab true and plumb.

B. Set risers as close to walls as possible where exposed.

C. Extend vents at least 1 foot above roof or extend further when required by code.

D. Properly slope sanitary and waste drainage piping encased in concrete.

E. Coordinate with affected trades the routing of drains through steel reinforcement.

F. Make all changes of direction in waste piping with combination Y and 1/8 bend fittings.

G. Install cleanout fittings and plugs where shown on Drawings, where required by code, and where reasonably required to facilitate pipe cleaning.

H. Install T or Y branches or trap hubs of the same material and size as the pipe in which they are placed for cleanout fittings.

I. Maximum cleanout size shall be 6 inches.

J. All joints shall be tight fitting, watertight, and without imperfections. Only manufacturer recommended lubricants shall be used.

3.3 SUPPORTS AND HANGERS

A. Support at the manufacturer's recommended span lengths, and at every joint and change of direction.

3.4 CORROSION PROTECTION

A. As specified in Section 15000, Plant Piping - General.

3.5 TESTING

A. All lines shall be hydrostatically tested at the pressures listed in the Piping Schedule and as required by plumbing laws, rules and regulations.

END OF SECTION

SECTION 15100

VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valve operators.

B. T-handled operating wrenches.

C. Valve boxes and extension stems.

D. Floor boxes and extension stems.

E. Chain wheels and guides.

F. Valve tagging requirements.

G. Gate valves.

H. Globe valves.

I. Ball valves.

J. Plug valves.

K. Butterfly valves.

L. Pinch valves.

M. Check valves.

N. Special valves.

O. Power operated valves.

1.2 SUBMITTALS

A. Submit shop drawings under the provisions of Division 1:
   1. Identify all submittal data with specified valve type number.
   2. Submit a valve schedule, identifying all valves by type number, pipeline, location, joint type, manufacturer and model or catalog number.
   3. Include all valves in a single submittal package. Partial or incomplete submittals will not be reviewed.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle valves under the provision of Division 1.

PART 2 PRODUCTS

2.1 GENERAL

A. Like items of equipment shall be the end product of one manufacturer.

B. All valves shall be complete with all necessary operating handwheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for the proper completion of the work included under this section.

C. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service.

D. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

E. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

F. For the purpose of designating the type and grade of valve desired, a manufacturer's name and list or figure number is given in the following specifications. Valves of equal quality by other manufacturers will be considered in accordance with Division 1.

2.2 VALVE TYPES

A. Valve types are specified by number. The type of valve to be used for each service and application is indicated on the Drawings by valve number call out. Note that this is a general valve specification so that some of the valve types listed herein may not be a part of the Work.

2.3 DESIGN FEATURES

A. Brass and Bronze Components:
   1. Brass and bronze components of valves and appurtenances that have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.
   2. Approved alloys are of the following ASTM designations:
      a. B61, B62, B98 (Alloy A, B, or D), B139 (Alloy A, B143 (Alloy 1-B), B164, B194, B292 (Alloy A), B127, and B584 (Alloy 844).
      b. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.
   3. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.4 VALVE OPERATORS

A. Equip all valves with handwheel operators, which open by turning counter-clockwise, unless otherwise shown or specified.

B. Proportion valve operator as to permit operation of the valve under full operating head with a maximum pull of 80 pounds on the handwheel or crank.

C. Worm and Gear Operators for Manually Operated Valves:
   1. Provide a totally enclosed design.
   2. Provide a self-locking type to prevent the disc or plug from creeping.
   3. Self-locking worm gears:
      a. One-piece design of AWWA gear bronze material, accurately machine cut.
      b. Provide a hardened alloy steel worm, with thread ground and polished.
   4. Provide proper lubricant for the reduction gearing.
   5. Provide with position indicators to show the position of the valve disc or plug.
   6. Paint the hand wheels the same color as the valve and associated pipeline.
   7. Gear operators shall be provided for all valves in buried or submerged operation.

D. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

2.5 T-HANDLED OPERATING WRENCHES

A. Provide two, "T" handle operating wrenches, 4 feet total length.

2.6 VALVE BOXES AND EXTENSION STEMS

A. Provide Buffalo two-piece sliding type, or screw type cast iron, with 5-1/4-inch shaft of approximate length for the installation.

B. Cast the word WATER, SEWAGE, GAS, DRAIN into the top of the lid, or label with a stainless steel tag as is appropriate for the service.

C. Provide extension pieces, if required, of the manufacturer's standard type. Units shall be Tyler, Bibby or equal.

D. Provide all units complete with all necessary bases and accessories.

E. Locate the operating nut 6-inches below the top of the valve box where the depth of valve operating nut is more than 3 feet below the top of the valve box.

F. Provide a 2-inch square operating nut.

G. Provide Type 304 stainless steel, galvanized or epoxy coated steel valve extension stems.

2.7 FLOOR BOXES AND EXTENSION STEMS

A. Provide a Clow F-5695, Neenah Foundry R 7506, DeZurik ACC*FB-6, or equal floor box.

B. Provide valve extension stems where required to locate the operating nut in the floor box.

C. Provide a 2-inch square operating nut.

D. Provide all necessary anchor bolts in Type 304 stainless steel.

E. Provide Type 304 stainless steel valve extension stems for submerged extension stem installations.

F. Provide galvanized or epoxy coated steel valve extension stems for all nonsubmerged extension stem installations.

2.8 CHAIN WHEELS AND GUIDES

A. Provide Walworth Company, Figure 804; Clow Valve Company, Figure F-5680; DeZurik Corporation, Series W or LWG; or equal chain wheels and guides.

B. Paint chain wheels and guides.

C. Size chains as recommended by the valve manufacturer and to extend within 4 feet of the operating floor.

D. Provide plated chains of the single loopcoil or babbitt type.

E. Where chains hang in normally traveled areas, provide appropriate "L" type tie back anchors and locate as directed by the Engineer.

2.9 VALVE TAGGING REQUIREMENT

A. Provide a valve tag for each power or air operated valve.

B. See Specification Section 15190 for valve tagging requirements.

2.10 GATE VALVES

A. V100: Gate valves 2 inches and smaller for steam service shall be all bronze with screwed bonnet and ends, single solid wedge gate, non-rising stem and hand wheel operator. Valves shall be rated 150-pound SWP, 300-pound WOG, and shall be Milwaukee Valve Company Figure 1105; NIBCO Figure T-113; or equal.

B. V105: Gate valves 2-1/2 inches and larger for air service shall be iron body, bronze mounted valves with flanged ends, solid wedge gate, and non-rising bronze stem. Valves shall be rated 125-pound SWP, 200-pound WOG, and shall be Crane Figure No. 461; Milwaukee Valve Company Figure F2882, NIBCO Figure F-619; or equal.

C. V109: Resilient seated gate valves conforming to the latest revision of AWWA Standard C-509 for general water service. Cast the word Open and an Arrow to indicate the direction to open the 2-inch square operating nut or hand wheel. Construct the wedge out of cast iron, and completely encapsulated with urethane rubber. Permanently bond the urethane sealing rubber to the cast iron wedge per the requirements of ASTM D429 tests for rubber metal bond. Construct stems for non-rising stem assemblies in full compliance with AWWA out of cast bronze with integral collars. Construct outside and yoke stems out of bronze bar stock. For non-rising stem valves, provide o-ring seal type stem stuffing boxes with two rings located above the thrust collar. The two rings shall be replaceable with the valve fully open and subjected to full rated working pressure. Locate two low torque thrust bearings above and below the stem collar. Make the stem nut independent of the wedge and out of solid bronze. Provide a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area. Coat the body and bonnet with fusion bonded epoxy both interior and exterior. Cast on the valve body the maker's name, pressure rating and year in which manufactured. Test each valve at the factory at a hydrostatic pressure equal to twice the specified working pressure. Valves shall be American Flow Company, American R/D Gate Valve Co. series 2000, Waterous Series 2500, no substitutions.

D. V110: Gate valves 2-1/2 inches and larger for water service, shall be iron body, bronze mounted valves with flanged ends, double disc gate, and non-rising bronze stem conforming to AWWA C500. Valves shall be rated 150-pound WOG minimum, and shall be American R/D Gate Valve Co. series 52, Clow Valve Company F-5070; Ludlow-Rensselaer Valve Division of Patterson Industries, Inc., List 13 AWWA; or equal.

E. V115: Gate valves 2-1/2 inches and larger for buried water service, shall be iron body, bronze mounted valves with mechanical joint ends, double-disc gate, non-rising bronze stem, O-ring sealed stuffing box, and 2-inch square wrench nut conforming to AWWA C500. Valves shall be rated 150-pound WOG minimum, and shall be American R/D Gate Valve Co. series 55, Clow Valve Company F-5065; Ludlow-Rensselaer Valve Division of Patterson Industries, Inc. List 13 AWWA; or equal.

F. V120: Gate valves 2-1/2 inches and larger for hot water service shall be iron body, bronze mounted valves with flanged ends, solid wedge gate, and outside screw and yoke. Valves shall be rated 125-pound SWP, 200-pound WOG, and shall be Crane Figure No. 465-1/2; Milwaukee Valve Company Figure F2885; NIBCO Figure F-617-0; or equal.

G. V150: Knife gate valves 18 through 30 inches shall be bonnetless wafer body type with outside stem and yoke, rated for 50 psi CWP minimum, with hand wheel or floor stand operators as shown on the Drawings. Valves shall be self-cleaning, non-clogging, with round port, raised face, and resilient neoprene seats. Valve shall provide drip-tight shutoff under the intended operating conditions. Valves shall have all wetted metal parts and stem of Type 304 stainless steel, yoke sleeve of acid-resisting bronze, and gate finish ground both sides with a sharp knife edge. Packing system shall be multiple layers of flax, or combinations thereof, to provide a leak-tight seal around the gate. Valve superstructure and yoke shall be designed to provide full and complete peripheral access to gland bolts when valves are equipped with manual or power actuators. Wafer knife gate valves shall be Sartell Valves & Controls GKU, Orbinox Series 20, Fabri-Valve Figure 37; Josam-Wey Valve Manufacturing Co. Model A1; Rovalve Figure 17; or equal.

H. V151: Knife gate valves 2 through 30 inches shall be bonnetless wafer body type with outside stem and yoke, rated for 50 psi CWP minimum, with hand wheel or steel extension stem with hand wheel operators as shown on the Drawings. Valves shall be self-cleaning, non-clogging, with round port, raised face, and resilient neoprene seats. Valve shall provide drip-tight shutoff under seating conditions. Valves shall have cast body, gate, super structure and stem of Type 304 stainless steel, yoke sleeve of acid-resisting bronze, and gate finish ground both sides with a sharp knife edge. Packing system shall be multiple layers of flax, or combinations thereof, to provide a leak-tight seal around the gate. Valve superstructure and yoke shall be designed to provide full and complete peripheral access to gland bolts when valves are equipped with manual or power actuators. Provide protective rubber boot over stem between gate and yoke sleeve. Wafer knife gate valves shall be DeZurik Series KGC or equal.

2.11 GLOBE VALVES

A. V200: Globe valves 2 inches and smaller shall be all bronze with screwed ends, union bonnet, inside screw, rising stem, and plug type disc with replaceable stainless steel plug and seat. Valves shall be rated 150-pound SWP, 300-pound WOG, and shall be Milwaukee Figure 591A; NIBCO Figure T-276-AP; Stocham B-62; or equal.

B. V201: Angle valves 2 inches and smaller shall be all-bronze with screwed ends, union bonnet, inside screw, rising stem, and plug type disc with replaceable stainless steel plug and seat. Valves shall be rated 150-pound SWP, 300-pound WOG, and shall be NIBCO Figure T-376-AP; Stocham Figure B-262; or equal.

C. V205: Globe valves 2-1/2 inches and larger shall be iron body, bronze mounted valves with flanged ends, renewable, composition disc and seat, outside screw and yoke, and bolted bonnet. Valves shall be rated 125-pound SWP, 200-pound WOG, and shall be Crane Co. Cat. No. 351; NIBCO Figure F-718-Y; or equal.

D. V210: Thermoplastic globe valves 4 inches and smaller for softened water service shall be rated 100 psi at 70 degrees F. Valves shall have socket welded ends and handwheel actuator valve. Body, bonnet, and stem shall be PVC. Valve disc shall be polypropylene. Valves shall be ASAHI/America Model B, or equal.

E. V220: Needle disc type globe valves shall be screwed bonnet, rising stem valves with bronze body and stem, rated 200-pound SWP, 400-pound WOG, Milwaukee Figure 600; Stockham Figure B-64; or equal.

F. V235: Angle type hose valves 1-1/2 inches and smaller shall have brass or bronze body, with rising stem and composition disc, rated 250-pound WOG minimum. Valves shall have male hose thread on the outlet and female NPT thread on inlet. Valves shall be Crane No. 17TF with Potter-Roemer Fig 2830 male to male adapter and Fig 4605 brass cap; or equal.

2.12 BALL VALVES

A. V300: Ball valves 2 inches and smaller, for general water and air service, shall be bronze, end entry type, one piece with screwed ends, reduced bore ports, Teflon seats,

and hand lever operators, rated 150 SWP, 720 CWP. Valves shall be Crane Co. Capri, Cat. No. 9302; NIBCO Figure T-585-70; Stockham Figure No. S-216-BR-R-T; or equal.

B. V302: Instrument air shutoff valves shall be brass body ball valves with nylon handles. Valves shall be Imperial Eastman Series 200; Whitey Series 40; or equal.

C. V307: Ball valves 2 inches and smaller shall have Type 316 stainless steel bodies with Type 316 stainless steel balls. Valves shall be of the 2 piece type with screwed ends, full bore rated 150 SWP, 600 CWP. Seat, body seal, and stem packing shall be reinforced TFE; valves shall have lever operators. Where required valves shall have an ISO mounting pad for pneumatic or electric actuator. Valves shall be Flow-Tek series 80 or 82; NIBCO T-580-56-R-66; Stockham Fig. No. S-206-SSMO-R-T; or equal.

D. V310: Ball valves 3 to 10 inches in size for general water and hot water service. Provide ANSI Class 150 flanged ball valves rated for continuous hot water service at 370° F and 150 psi. Provide a carbon steel bodied, end entry type, one piece ball valve with ANSI Class 150 flanged ends, 316 stainless steel ball and stem, and reinforced TFE seats and seals. Valves shall be Apollo 88-140 Series; Flow-Tek model RF15; NIBCO 510 Series; or equal.

E. V330: Thermoplastic ball valves 2 inches and smaller shall be rated 150 psi at 105 degrees F, with ASTM D 1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem. Valves shall be of end entry, true union design, with solvent weld socket ends. Valves shall have replaceable elastomer seats and Viton or Teflon O-ring stem seals. Valves for ferric chloride service shall have EPDM seats and O-ring stem seals; Viton is not acceptable. Valves shall have handle for manual operation. Single union ball valves with flanged ends drilled to 150-pound ANSI standard are also acceptable, including Chemtrol Series TU-TB as manufactured by Chemtrol, Division of NIBCO, Louisville, KY; GSR valves as manufactured by R&G Sloane Manufacturing Company, Inc., a subsidiary of the Susquehanna Corp., Woodland Hills, CA; d (no longer made and no longer Hills McCanna) or equal.

F. V331: Thermoplastic ball valves 3 inches and larger shall be double entry type, with ASTM D 1784, Type I, Grade 1 polyvinyl chloride full port bodies and solvent-weld, dual-union ends, rated 150 psi at 105 degrees F. Valves shall have Teflon seats and Viton O-ring stem, face and carrier seals. Valves for ferric chloride service shall have EPDM seats and O-ring stem, Face A Carrier seals; Viton is not acceptable. Valves shall have handle for manual operation. Single union ball valves with flanged ends drilled to 150-pound ANSI standard are also acceptable, including Chemtrol TU-TB Division of NIBCO Series as manufactured by Chemtrol, Inc., Louisville, KY; GSR valves as manufactured by R&G Sloane Manufacturing Company, Inc., a subsidiary of the Susquehanna Corp., Woodland Hills, CA; or equal.

G. V350: Ball valves shall be Vee-Port Ball valves with 150-pound ANSI, cast iron body, Type 316 stainless hard chrome face, reinforced PTFE seat, valve shaft 316 hardened stainless steel and multiple ring PTFE packing. Valve shall be DeZurik, Model VPB, F, 4, FT; or equal.

2.13 PLUG VALVES

A. V400: Eccentric plug valves 3-inches and smaller shall be of the nonlubricated type with attached wrench lever manual operator, rated 175-pound WOG. Valves shall have a cast iron body with screwed ends, balanced plug coated with Hycar or neoprene elastomer, and O-ring seals. Valves shall be DeZurik Water Controls PEC, Val-Matic; or equal.

B. V405: Eccentric plug valves 3 inches through 24 inches shall be of the nonlubricated type with wrench lever manual operators for valves 8 inches and smaller and manual gear operators for valves 10 inches and larger. Valves shall be rated 150-pound WOG minimum, rectangular port with minimum 80% port area and shall have a cast iron body ASTM A 126 Class B with flanged ends, balanced plug coated with Hycar or Neoprene elastomer, Buna-Vee packing that shall be adjustable and replaceable under pressure in the line, stainless steel bearings, and nickel or stainless steel seats. Minimum seat thickness of 1/8" required no sprayed or Plated seats are acceptable. Valve shall be provided with grit seal for protection of lower body bearing and grease fitting shall be included in upper and lower bearing except for buried and submerged services. Flanges shall be drilled and faced to 125-pound ANSI Standards. DeZurik Water Controls PEC or PEF Sartell, MN; Victaulic Series 365; Val-Matic or equal.

C. V406: High pressure eccentric plug valves 4-inches through 12-inches shall be of the non-lubricated type with manual gear operators for valves 4-inches and larger. Valves shall be rated for 285-pound CWP and shall have carbon steel (ASTM A216 Grade WCB) body with flanged ends, rectangular port with minimum 100% port area), cast iron balanced plug with hycar or neoprene elastomer, Buna-Vee packing that shall be adjustable and replaceable under pressure in the line, stainless steel bearings, and nickel or stainless steel seats. Flanges shall be drilled and faced to 125-pound ANSI standards. Valves shall be DeZurik Water Controls PEC Sartell, MN; Val-Matic; or equal.

D. V410: Eccentric plug valves 4 inches through 20 inches shall be round-ported valves of the non-lubricated type with wrench lever manual operators for valves 6 inches and smaller and manual gear operators for valves 8 inches and larger. Valves shall be rated 150-pound WOG minimum, and shall have a cast iron body with flanged ends, balanced plug coated with Hycar or EPT elastomer, Buna-Vee packing or O-ring seals corrosion resistant bearings, and nickel, stainless steel or bronze seats. Flanges shall be drilled and faced to 125-pound ANSI standards. Valves with rectangular ports are not acceptable. Valves shall be Victaulic Series 365; or equal.

E. V420: Curb stops (Curb valves) shall be 1" Mueller B-25155, AY 61040, or Ford B-44-444M, B-44-455M. No flare fittings will be allowed. Curb boxes shall be Mueller H-10300 (Minneapolis Pattern), AY 5614; 5615, or equivalent with extended length of 6-1/2 feet.

F. V421: Corporation stops shall be Mueller 825008, AY 470180, or Ford FB1000-4, FB1000-45, FB1000-5, FB1000-6. Corporations larger than one-inch shall be Smith Blair 317 or equal. A service saddle shall be used on any tap larger than one-inch.

G. V440: Non-lubricated tapered plug valves 2 inches and smaller shall have ductile iron or carbon steel bodies with straight-way rectangular ports, Teflon sleeves, screwed ends, and wrench operators, Class 150, rated 275 pounds WOG. Valves shall be Southern

Manufacturing Prermaseal; Duriron Company Figure No. G432, Tufline Figure 066; or equal.

H. V445: Non-lubricated plug valves 2½-inches and larger shall have ductile iron or carbon steel bodies with straight-way rectangular ports, Teflon sleeves, 316 stainless steel plug, and flanged ends, Class 150 rated 275 pounds WOG. Valves shall be Southern Manufacturing Prermaseal; Duriron Company Figure No. G411; Tufline Figure 067; or equal. Valves 4 inches and smaller shall be wrench operated, 6 inches and larger manual gear operators.

I. V450: Digester gas service, lubricated plug valves 2 inches and smaller shall have high strength cast iron or semi-steel bodies, with straight-way rectangular ports, screwed ends, and wrench operators, rated 175-pound WOG minimum. Valves shall provide driptight shut off with pressure in either direction and shall be factory tested for shut off utilizing a dry seat test. Valves shall be Walworth Company Figure No. 1796; Homestead Industries Figure 601 or 611; or equal. We do not recommend lubricated plug valves for digester gas service and as a reference at Burlington WWTP we replaced the lubricated plug valves after only a few years of service.

J. V455: Digester gas service, non-lubricated, tapered plug style valves 1/2 inches through 6 inches shall have ductile iron body and 316 stainless steel plug. Valve shall be rated ANSI Class 150 with ANSI B16.5 flanges. Valve seats shall be field replaceable without removing valve from the pipeline. Packing shall be self-compensating for temperature changes. Valve shall have a positive stop mechanism for visual identification of plug position. Valves shall provide driptight shut off with pressure in either direction and shall be factory tested for shut off utilizing a dry seat test. Valve shall be Southern Manufacturing Permaseal, Tufline; or equal.

K. V456: Digester gas valves 8" and larger shall be of the non-lubricated eccentric type rectangular port with minimum 80% port area with nitrile-butadiene resilient faced plugs and shall be furnished with flanged end connections. Valve bodies shall be of ASTM A126 Class B cast iron compliance with AWWA C504 Section 2.2. Furnished bodies with a welded overlay seat of not less than 90% pure nickel, minimum thickness of 1/8", and in accordance with AWWA C507 Section 7.2. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Valves shall have sleeve type metal bearings conforming to AWWA C504-80, Section 3.6 and AWWA C507-73, Section 8. Bearings shall be of sintered, oil impregnated and permanently lubricated type 316 ASTM A743 Grade CF-8M or AISI Type 317L stainless steel. Valve shaft seals shall be of the multiple V-ring type and shall be externally adjustable, repackable without removing the bonnet or actuator from the valve, and repackable under pressure. Valves shall provide driptight shut off with pressure in either direction and shall be factory tested for shut off utilizing a dry seat test. Valve shall be DeZurik Water Controls PEC, or equal.

L. V460: Drain cocks, 1-inch and smaller, shall be 125-pound bronze body square-head type with screwed ends and stop, Central United Corp., Milwaukee, WI, Figure 150; or equal.

M. V462: Gauge cocks shall be 1/4-inch bronze body valves, hexagon end pattern with tee head and male and female ends, rated for 125-pound SWP. Cocks shall be Lunkenheimer Figure 1180; Crane No. 744; or equal.

N. V470: Combination balancing and shutoff valves 2 inches and smaller for heating, chilled, and cooling water services shall be non-lubricated plug valves with semi-steel body, attached wrench lever manual operator, EPT or Isobutone-Isoprene resilient plug facing, and adjustable memory stop. Valves shall be rated 175-pound WOG and shall be furnished with screwed ends. Valves shall be Keyport Series 400, Figure 425S; or equal.

O. V472: Combination balancing and shutoff valves 2-1/2 inches and larger for heating, chilled, and cooling water services shall be non-lubricated plug valves with semi-steel body, wrench lever manual operator unless otherwise shown, EPT or Isobutone-Isoprene resilient plug facing, and adjustable memory stop. Valves shall be rated 150-pound WOG minimum and shall be furnished with 125-pound ANSI flanged ends. Valves shall be DeZurik Water Controls PEC; or equal.

2.14 BUTTERFLY VALVES

A. General: All butterfly valves and operators, except as herein otherwise noted, shall conform to AWWA C504, latest revision. All valve shafts shall be connected to operators by the use of keys and keyways. The use of compression or friction connections is not acceptable. The seat shall be in the valve body and shall be continuous around the periphery of the disc and shall not be penetrated by the valve shaft. Also the seat shall be adjustable and replaceable without removing the disc from the valve body on valves 30 inches and larger.

B. V500: Standard service butterfly valves 10 inches and smaller shall be flanged end, short body type, AWWA Class 150B, with manual locking hand lever operators. Provide hand wheel manual operators of the traveling nut, self-locking type where required. Valves shall have ASTM A 126, Class B cast iron valve body with 125-pound full face flanges drilled in accordance with ANSI B16.1. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A 536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion resistant sleeve type bearings. Valve seat shall be attached to the valve body and shall be of Hycar, except valves for low pressure air service shall have EPDM seats. Valves shall be DeZurik Water Controls Model BAW; Henry Pratt Company Model 2FII; or equal.

C. V501: Wafer butterfly valves 12 inches and smaller for general service shall have semi-steel body, aluminum bronze disc, Type 416 stainless steel stem (AWWA C504, Class 75B minimum), reinforced TFE or TFE-coated stainless steel or Acetal bearings at both ends, and EPDM replaceable resilient seat. Valves shall be bubble-tight at 175 psi differential pressure and shall be suitable for installation between ANSI 125- and 150-pound flanges. Valves shall be hand- 10 position lever operated Bray Series 30; DeZurik Model BRS; or equal.

D. V502: Lug wafer butterfly valves 12 inches and smaller in general service shall have semi-steel bodies with aluminum bronze disc, Type 416 stainless steel stem (AWWA C504, Class 75B minimum), reinforced TFE or TFE-coated stainless steel or Acetal bearings at both ends, and Buna-N/Hycar replaceable resilient seat. Valves shall be

bubble-tight at 175 psi differential pressure and shall be suitable for installation between ANSI 125-and 150-pound flanges. Valves shall be hand 10 position lever or chain operated Bray Series 31; DeZurik Model BRS; or equal.

E. V505: Standard service butterfly valves 10 inches through 20 inches shall be flanged end, short body type, AWWA Class 150B, manual gear operator. Valves shall have ASTM A 126, Class B cast iron valve body with 125-pound full-faced flanges drilled in accordance with ANSI B16.1. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A 536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seat shall be attached to the valve body and shall be of Hycar. Valves shall be DeZurik Model BAW; Henry Pratt Company Model 2FII; or equal.

F. V507: Standard service butterfly valves 12 inches through 20 inches inclusive shall be wafer body type, AWWA Class 150B with manual gear operators. Valves shall have ASTM A 126, Class B cast iron valve body with bearing housing size and location such that 125-pound, ANSI B16.1 bolt layout is usable. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A 536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating corrosion-resistant sleeve type bearings. Valve seating shall be attached to the valve body and shall be of neoprene or Hycar. Valve seats attached to the valve body shall cover the entire inner surface and outside faces of the valve body. Valves shall be Crane Company AWWA Model 21F; Henry Pratt Company Monoflange MKII; or equal.

G. V509: High performance butterfly valves, sizes 2"-48" in ANSI Class 150 design lugged body style. Bodies shall be carbon steel construction. Bodies shall be designed to accept interchangeable seats of PTFE construction. Carbon steel body valves shall provide drip-tight shutoff to 275 psi and 720 psi respectively. Valves shall be of the single offset shaft/disc design to provide uninterrupted 360° seating and to minimize pressure imbalance applied to the disc during operation or at closure. Lug body valves shall provide drip-tight shutoff to the full valve rating on dead end or isolation service without a downstream flange. All valves shall be furnished with replaceable upper and lower shaft/thrust bearings to assure disc centering in the seat without the use of shims. Bearings shall be of composite design with a 317 stainless steel carrier and 317 backed PTFE/fiberglass replaceable liners. Valves to be furnished with adjustable v-ring packing of PTFE and an externally adjustable packing gland. Shafts shall be of one piece design and shall be strain hardened type 316 stainless steel. Valve seats shall be of Reinforced PTFE with an integral seat energizing ring of titanium, Inconel (for oxidizing service) or encapsulated silicone rubber capable of service in temperature ranges of -100° to 450°F. Seat design shall be a dual-seal type with pressure assisted and mechanical seat to disc sealing features and capable of drip-tight bi-directional shutoff. Discs shall be 316 stainless steel. Valve Shall Be Bray Series 41, 43; or DeZurik Model BHP.

H. V510: Standard service butterfly valves 24 inches and larger shall be flanged end, short body type, AWWA Class 75B minimum, with AWWA enclosed manual hand wheel operators. Valves shall have ASTM A 126, Class B cast iron valve body with 125-pound full-faced flanges, drilled in accordance with ANSI B16.1. Valve disc shall be contoured ASTM A 126, Class B cast iron or ASTM A 536, Grade 65-45-12 ductile iron. Valve shaft shall be Type 304 stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Stub shafts shall be considered standard on valves 36 inches and larger.

Valve seats shall be attached to either the valve body or the disc and shall be of neoprene. Where indicated on the Drawings, provide operator extension bonnets. Valves shall be DeZurik Water Controls BAW; Henry Pratt company Triton XR-70; or equal.

I. V515: Buried service butterfly valves 24 inches and larger for low pressure air service shall have ANSI 125# flanges Class 25A Pressure service and buried construction buried gear actuators with extension stem and three piece cast iron valve box. Valve disc shall be contoured ASTM A 48, Class 40 cast iron or ASTM A 536. The disc seating edge shall be 316 stainless steel. Valves shafts shall be 304 stainless steel. Valve shaft bearings shall be non-cold flowing, metal backed PTFE. Valve shaft seals shall be molded in place EPDM rubber for 250 degrees air surface. Valves shall be DeZurik Model BAW-25A; or equal.

J. V520: Corrosive service buried butterfly valves sizes 2" - 12" shall be of the lug wafer body style. All valves shall be suitable for use with ANSI 125 or 150 pound flanges. Bodies shall be cast iron. Valves shall be rated at 150 psi and provide drip-tight shutoff at differentials up to 150 psi. The seat shall be a PTFE w/ EPDM rubber backing. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing lips and provide tight shutoff up to the full valve rating. Valve shall be furnished with self-lubricated bearings of Acetal composition or TFE coated stainless steel. Shafts shall be 17-4PH stainless steel. Discs shall be PFA coated 17-4 stainless steel. Valves shall be Bray Series 21 or equal.

K. V521: Corrosive service buried butterfly valves sizes 14" - 24" shall be of lug wafer body style. All valves shall be suitable for use with ANSI 125 or 150 pound flanges. Bodies shall be 316 stainless steel. Valves shall be rated at 150 psi and provide drip-tight shutoff at differentials up to 150 psi. Seat shall be PTFE with integral seat energizing titanium or encapsulated silicone backup ring. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall provide tight shutoff up to the full valve rating. Valve bearings shall be self-lubricated bearings of Nylon composition or TFE coated stainless steel. Shafts shall be 17-4PH or 316 stainless steel. Discs shall be 316 stainless steel. Valves shall be Bray Series 41; or DeZurik Corporation Model BHP, *, L1, S2, TC, S2-S2-FT-TT.

2.15 PINCH VALVES

A. V705: Pneumatically operated pinch valves 10-inch and smaller shall be full port, cast iron body, Buna-N sleeve, and shall be furnished with 125-pound ANSI B16.1 flanged ends. Air inlet shall be 1/4" NPT and valve shall achieve full closure at 30 psi over line pressure. Working pressure shall be a minimum of 50 psi. Valve shall be Red Valve Type A; Flex Valve Series 2100 or equal.

2.16 CHECK VALVES

A. V800: Check valves 2 inches and smaller shall be all-bronze, with screwed ends and cap, regrinding seat, Y-pattern body, and swing type disc. Valves shall be rated for 125-pound SWP, 200-pound WOG, and shall be Crane Cat. No. 37; Milwaukee Valve Company Figure 509; NIBCO Figure T-413-B; or equal.

B. V801: Spring check valves 1 inch and smaller for sodium hydroxide, sodium hypochlorite, ferric chloride, and sulfuric acid service shall be of poppet design with Teflon body, seat and poppet, 316 stainless steel Teflon-coated spring, NPT threaded ends, and rated 50 psi at 150 degrees F. Valves shall be BIVCO Series 6000 as manufactured by Circle Seal Controls, Anaheim, CA; or equal.

C. V805: Check valves 2-1/2 inches through 12 inches inclusive shall be flanged end, cast iron body, bronze mounted swing type, with solid bronze hinges and stainless steel hinge shaft. Valves shall be rated 200-pound WOG, and shall be Crane Co. Cat. No. 373; List 37, Clearway check valves as manufactured by Ludlow-Rensselaer Valve; Hammond; or equal.

D. V807: Check valves 2-1/2 inches through 12 inches inclusive shall be flanged end, cast iron body, bronze mounted swing type, with solid bronze hinges, stainless steel hinge shaft, and outside lever and weight. Valves shall be rated 200-pound WOG, and shall be Crane Co. Figure 383; or equal.

E. V810: Check valves 2-1/2 inches through 12 inches inclusive shall be flanged end, all-iron swing checks with stainless steel hinge shafts. Valves shall be rated 200-pound WOG, and shall be Crane Co. 373-1/2; Walworth No. W928-1/2; or equal.

F. V812: Check valves 2-1/2-inches through 12 inches inclusive shall be flanged end, all-iron swing checks, with stainless steel hinge shafts and outside lever and weight. Valves shall be rated 200-pound WOG, and shall be Walworth No. W-928-1/2F; or equal.

G. V814: Check valves 2-1/2 inches through 12 inches inclusive shall be flanged end, iron body and disk, stainless steel trim, resilient seat, with outside lever and weight and air-cushion chamber. Valve shall be APCO Series 6000, GA Industries Figure 250-D, or equal.

H. V815: Check valves 2-inches through 10-inches inclusive shall be flanged end with cast iron body. Check valve shall be the flexible rubber swing type with top access allowing removal of the disc without removing the valve from the pipeline. Disc shall be Buna-N one piece construction, compression molded with an O-Ring type sealing surface, and nylon and steel reinforcement. Valve interior shall be coated with a high build epoxy or rubber. Valves shall be APCO Series 100R; Val-Matic Series 500, GA Industries Figure 200-D or equal.

I. V820: Check valves for low pressure process air service on centrifugal blower shall be iron body type with ANSI 150-pound flanged or grooved ends, rated 150 psig at 200 degrees F. Valve shall have bronze split disc mounted on Type 316 stainless steel center post, such that wafer type butterfly valve can be mounted directly downstream of check valve when discs of both valves are in the open position. Valves shall be Mission Duo-check Model 12HMP as manufactured by Mission Manufacturing Co., Houston, TX; Technocheck as manufactured by Techno Corporation, Erie, PA; US Valve, or equal.

J. V821: ½" through 2½" check valves for low pressure air on P.D. blowers shall be aluminum body and internals, threaded ends, and shall have silicone seal rated -100° to 500°F. Check valves shall be Technocheck model 5002-AL, US Valve, or equal.

K. V822: 3" and larger check valves for low pressure air on P.D. blowers shall be cast iron wafer style body, aluminum internals, and shall have silicone seal rated -100° to 500°F. Check valves shall be Technocheck model 5118 or equal. Where check valves mounts directly to a butterfly valve the check valve shall have 125# flanged long pattern steel body. Check valve shall be Technocheck model 5081-F or equal.

L. V825: Air compressor discharge check valves shall have screwed or flanged ends, as required by the application. Valves shall be 150-pound rated, airtight disc valves, with stainless steel discs and springs. Valves shall be designed specifically to give nonchatter, nonslam performance when installed in air compressor discharge lines, and shall be as manufactured by Hoerbiger Corporation of America; US Valve, or equal.

M. V840: Thermoplastic ball check valves 4 inches and smaller shall have ASTM D 1784, Type I, Grade 1 polyvinyl chloride body with dual union socket weld ends, rated 150 psi at 75 degrees F. Valves shall be equipped with Viton seats and seals. Alternatively, single union check valves with flanged ends drilled to 150-pound ANSI standard may be used, including ball check valves manufactured by Chemtrel, Division of NIBCO Inc., Louisville, KY; Hayward Manufacturing Co., Inc., Elizabeth, NJ; R&G Sloane Manufacturing Co., Inc., a subsidiary of Susquehanna Corp., Woodland Hills, CA; or equal.

N. V860: Check valves 2 inches and smaller for heating, chilled, and cooling water piping systems shall be all- bronze type silent check valves with screwed ends, rated 300-pound WOG. Valves shall be Combination Pump and Valve Company No. 36; Mueller Steam Specialty No. 303-BP; or equal.

O. V862: Check valves 2-1/2 inches and larger for heating, chilled, and cooling water piping system shall be flanged type silent check valves with ANSI B16.1, 125-pound flanges and 125-pound ANSI iron (semi-steel) body and bronze trim, rated 175-pound WOG. Valves shall be Clow F-3074; Mueller Steam Specialty No. 105-AP; or equal.

P. V870: Ball check valves 3 inches and larger shall be iron body with a sinking type hollow steel ball. Valve body interior surface and ball exterior surface shall be coated with nitrile rubber. Flanges shall be ANSI B16.1, Class 125 flat faced. Valve shall be rated 150-pound WOG, suitable for vertical up or horizontal flow. Valves shall be FLYGT; HDL; G.A. Industries Figure 240; or equal.

Q. V871: High pressure ball check valves shall be ductile iron body with a sinking type hollow steel ball. Valve body interior surface and ball exterior surface shall be coated with nitrile rubber. Flanges shall be ANSI B16.1, Class 250. Valve shall be rated 250 pound WOG, suitable for vertical up or horizontal flow. Valves shall be Flygt; HDL; G.A. Industries; or equal.

2.17 SPECIAL VALVES

A. V915: Mud valves shall have cast iron body with bronze disc and seamless molded neoprene seat ring. The frame shall be flanged, with non-rising type stem. The valves shall be provided with bronze extension stem and 2-inch square operating nut for floor box operation. Provide stem guides for maximum unsupported stem length of 5 feet. The valves shall be Clow F-3075; Troy A-25600RB; or equal.

B. V920:

1. Three way plug valves for digested sludge service shall be of the non-lubricated tapered plug type. Manual valves shall be available with metal-to-metal seating or with resilient faced plugs for drip tight shutoff. End connections shall be flanged and shall be drilled to ANSI 125/150 pound standard. Valves shall be cast iron. All valves shall have stainless steel bearings in the upper and lower journal areas. All three-way valves shall be furnished as standard with a plug to shut off one port at a time.
2. Manual valves where drip tight shut off is not required shall be metal-to-metal seated and shall be available with single hand wheel actuators. Levers shall be of the lift, turn and reseat type to provide single lever valve operation and shall be furnished with a locking device to hold the plug in the desired position. Hand wheel actuators for metal-to-metal seated or hard rubber lined valves for flow diverting shall be totally enclosed and shall be of the worm and gear type.
3. All manual and power actuated valves shall be available with all required operating accessories as specified.
4. All valves, actuators, and accessories shall be Model #PTW,4,F1,CI,6,S-1-M*SA07.5-13B/GS-6,as manufactured by DeZurik; or equal.

C. V925: Sampling valves shall be iron body type with stainless steel piston that extends to the inner surface of the vessel or pipe. The valve shall be sealed by two compressible, replaceable Teflon rings, one above the discharge port and the other below the discharge port. Valves shall be Strahman Sampling Valve; Walworth Drain Valve; or equal.

D. V930: Fire hydrant shall be American Flow Control, Waterous Hydrant, Model B-84-B, 7-feet 0-inch bury, 6-inch mechanical joint inlet, and shall be identical to other fire hydrants in the city, no substitutions.

E. V950: Yard hydrant shall be a frost-proof post hydrant for outdoor installation, bronze construction, cast iron casing guard, "T" handle key, with drain hole and valve seat 6 feet below grade. Hydrant shall have NPT inlet and hose connection outlet, and shall be Jay R. Smith Mfg. Co., Figure 5910-5914; Zurn; or equal.

F. V951: Yard hydrant shall be a frost-proof box hydrant for outdoor installation set flush with ground surface. Bronze construction; cast iron box with hinged, locking cover; "T" handle key; with drain hole and valve seat 6 feet below grade. Hydrant shall have NPT inlet and hose connection outlet, and shall be Jay R. Smith Mfg. Co., Figure 5810-5814; Zurn; or equal.

G. V955 - Non-Freeze Wall hydrant: Frost-proof design similar to ASME A112.21.3M, for wall mounting with "T" handle key operation, NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, casing and operating rod to match wall thickness, and projecting outlet with ASME B1.20.7 garden-hose threads on outlet. Include wall clamp; integral vacuum breaker or nonremovable, drainable hose-connection vacuum breaker complying with ASSE 1011 ; and garden-hose threads complying with ASME B1.20.7 on outlet. Acceptable manufacturers: NIBCO INC., Sioux Chief Manufacturing Co., Inc., Watts,Industries, Inc.; Water Products Div., Woodford Manufacturing Co., Zurn Industries, Inc.; Jonespec Div.

H. V971: Natural Gas Pressure Regulating Valves: Provide pressure regulating valves of manufacturers standard materials for natural gas service. Pressure regulators shall be vented, self-operated, spring-loaded type sized equal to the line size upstream of the regulator or sized one pipe size smaller as required based on the required pressure and flow. Valves shall be Fisher Series S202; or equal and shall meet all applicable state and local codes. Provide venting to the building exterior when the regulators are located inside the building.

2.18 POWER OPERATED VALVES

A. V1010: Solenoid valve: Process solenoid valves shall be forged brass body Teflon seat, Type 305 stainless steel core tube, Type 430F stainless steel core and plug nut, Type 302 stainless steel springs, suitable for an inlet working pressure of 275 psig. Solenoid valves shall not require a minimum pressure to either open or close. Solenoid valve shall be rated 120-volt, single-phase, and shall have a NEMA 7 explosion-proof enclosure. Valves shall be ASCO Red Hat Model 8211 Magnetrol; or equal.

B. V1015: Solenoid valves shall be brass body with BUNA "N" seat, Type 305 stainless steel core tube, Type 430 F stainless core and plug nut, Type 302 stainless steel springs, suitable for an inlet working pressure of 125 psig. Solenoid valves shall be capable of operating at a minimum pressure differential of 5 psi and shall be normally closed. The valves shall be rated at 120 VAC, Single Phase, and shall have a NEMA 4X enclosure. Valves shall be ASCO Red Hat II 8210G9; or equal.

PART 3 EXECUTION

3.1 GENERAL

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads before making joints. Joints shall be watertight at test pressures before acceptance.

3.2 PLACING

A. Where centerline of manually operated valves are over 6 feet 9 inches above the floor line, chain wheel and guide assemblies or chain lever assemblies shall be furnished and installed for operation of the valves, unless otherwise directed by the Engineer.

B. Generally, unless otherwise indicated on the Drawings, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the

finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

C. Curb stops shall be located on the property line.

D. Corporation stops:
   1. For PVC water mains, a shell-type cutter with multiple cutting teeth shall be used for tapping service connections, as follows:
      a. Corporation stops shall not be located closer than one (1) foot from pipe joints. Insertions on opposite sides of the main, shall be separated by a minimum of one (1) foot. Insertions on one side of the main shall be staggered and separated by a minimum of one (1) foot.
      b. Teflon tape shall be placed on the corporation stop threads prior to installation.

3.3 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage before final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. Correct any damage caused by the testing.

B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished and/or that he has complied with these and other referenced specifications.

3.4 MANUFACTURER'S SERVICES FOR POWER OPERATED VALVES

A. Provide manufacturer's services under the provisions of Division 1.

B. Minimum Service Requirements:
   1. Installation: As required for proper installation.
   2. Operator training: One full day on site.
   3. Service to Repair Defective Work: Provide during one-year warranty period under the provisions of General Conditions.

END OF SECTION

SECTION 15135

METERS AND GAUGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temperature Gauges and Fittings:
   1. Glass thermometers.
   2. Dial type insertion thermometers.
   3. Thermometer wells.

B. Pressure Gauges and Fittings:
   1. Pressure gauges for HVAC.
   2. Pressure gauges, pressure switches and seals for process systems.
   3. Pressure gauge cocks.
   4. Pressure-temperature gauge connector plugs.
   5. Gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 15 sections.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI B16.1-89 - Cast-Iron Pipe Flanges and Flanged Fittings.
   2. ANSI B26.24-79 - Bronze Pipe Flanges and Flanged Fittings Class 150 and 300.
   3. ANSI B31.1-89 - Power Piping.
   4. ANSI B40.1-85 - Gauges-Pressure Indicating Dial Type - Elastic Element.

B. Instrument Society of America (ISA).

1.3 SUBMITTALS

A. Product Data: Submit under the provisions of Division 1, including the following:
   1. Manufacturer's technical product data, including installation instructions, for each type meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated.
   2. Meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

B. Operation and Maintenance (O&M) Data:
   1. Maintenance data and spare parts lists for each type of meter and gauge.
   2. Submit in accordance with Division 1.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of meters and gauges, of types and sizes required, whose products have been in satisfactory use in similar service.

B. Regulatory Requirements:
   1. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
   2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

C. Certification: Provide manufacturer certified meters and gauges meeting accuracies of specified operating conditions.

PART 2 PRODUCTS

2.1 GLASS THERMOMETERS

A. Manufacturers:
   1. Marshalltown Instruments, Inc.
   2. Palmer, Inc.
   3. Weiss Instruments, Inc.
   4. Or equal.

B. Provide glass thermometers of materials, capacities, and ranges indicated, designed, and constructed for use in service indicated.

C. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9-inches long.

D. Adjustable Joint: Die cast aluminum, finished to match case, 180º adjustment in vertical plant, 360º adjustment in horizontal plane, with locking device.

E. Tube and Capillary: Magnifying lens, 1% scale range accuracy, shock mounted.

F. Scale: Satin faced, non-reflective aluminum, with permanently etched markings.

G. Stem: Copper plated steel or brass for separate socket. Length to suite installation.

H. Range:
   1. Hot Water: 30º to 240º F with 2º F scale divisions.
   2. Chilled water: 30º to 100º F with 2º F scale divisions.

2.2 REMOTE READING DIAL THERMOMETERS

A. Manufacturers:
   1. Marshalltown Instruments, Inc.
   2. Palmer, Inc.
   3. Weiss Instruments, Inc.
   4. Or equal.

B. Provide glass thermometers of materials, capacities, and ranges indicated, designed, and constructed for use in service indicated.

C. Case: Wall mounted.

D. Case Size: 4 ½-inch.

E. Crystal: Glass cover.

F. Dial Face: Black lines and numbers on white background. Black adjustable printer. Linear scale.

G. Capillary: Stainless steel capillary protected by a ¼" diameter flexible stainless steel armor. Capillary length as required.

H. Bulb actuated dial.

I. Schedule & Range:
   1. Thermometers: Not Required.
   2. Discharge Air Temperature: 30º to 240º F with 2º F scale divisions.

2.3 THERMOMETER WELLS

A. Manufacturer: Same as thermometers.

B. Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure.

C. Provide cap nut with chain fastened permanently to thermometer well.

D. Provide 2-inch extension for insulated piping.

2.4 PRESSURE GAUGES FOR HVAC

A. Manufacturers:
   1. Marshalltown, Instruments, Inc.
   2. Palmer, Inc.
   3. Weiss Instruments, Inc.
   4. Or equal.

B. Provide pressure gauges of materials, capacities and ranges indicated designed, and constructed for use in service indicated.

C. Type: General use, 1% accuracy, ANSI B40.1 Grade A phosphor bronze bourbon type, bottom connection.

D. Case: Drawn steel or brass, glass lens, 4 ½-inch diameter.

E. Connector: Brass with 1/4 inch male NPT. Provide protective siphon when used for steam service.

F. Scale: White coated aluminum with permanently etched markings.

G. Range:
   1. Water: 0 to 100 PSI or as indicated during shop drawing review.

2.5 PRESSURE GAUGES, PRESSURE SWITCHES AND SEALS FOR PROCESS SYSTEMS

A. General:
   1. Provide gauges for the suction and discharge of pumps as shown on the Drawings.
   2. Provide diaphragm seals for all sludge piping system gauges and as shown on the Drawings.
   3. Gauge scale: As shown on the Drawings or provided during shop drawing review.

B. Pressure Gauges:
   1. Manufacturer:
      a. Ashcroft Model 1279 greater than 10 psig.
      b. Ashcroft Model 1188 less than 10 psig.
      c. Or equal.
   2. Dial Size: 4 ½-inch unless otherwise noted.
   3. Gauge Case Material: Phenolic plastic with stainless steel snap ring.
   4. Sensing Element Material:
      a. Bourdon tube: Phosphor-bronze.
      b. Bellows: Brass.
   5. Provide a liquid filled gauge.

C. Pressure Differential Gauges:
   1. Manufacturer:
   2. ITT Barton Model 227 or 200.
   3. Or equal.
   4. Dial Size: 4 ½-inch unless otherwise noted.
   5. Accuracy: +2 percent of full scale.
   6. Provide zero adjustment accessible from front.
   7. Scale: Linear unless noted otherwise.
   8. Connections: 1/8-inch NPT.

D. Manometers:
   1. Manufacturer:
      a. Dwyer Instruments, Inc., Model No. 1230.
      b. Or equal.
   2. Scale: Minimum 20-inches of water unless otherwise noted.
   3. Fluid: Red Oil.

E. Pressure Switches:
   1. Manufacturer:
      a. Mercoid, Series DA.
      b. Or equal.
   2. Enclosure: NEMA 4X, unless otherwise noted.
   3. Switch Function: Single point adjustable deadband, SPDT contact, minimum 10 amps, continuous at 120 VAC.
   4. Wetted Materials: Stainless steel and Buna-N.

5. Adjustable Operating Range: As scheduled.
6. Setpoint: As scheduled, provide external manual adjustment knob.
7. Provide with external manual reset.

F. Diaphragm Seals:
1. Manufacturer:
   a. Ashcroft Series 100.
   b. Or equal.
2. Pressure Rating: 1500 psig.
3. Bottom and Top Housing Material: AISI 316 stainless steel.
4. Diaphragm Materials: AISI 316L stainless steel.
5. Filling Fluid: Glycerin or manufacturers recommended fluid for material compatibility.
6. Manufacturer to assemble, fill, and calibrate associated pressure gauge and switch.

G. Annular Seals:
1. Manufacturer:
   a. Red Valve Series 40.
   b. Or Equal.
2. Measures pressure 360° around full inside circumference.
3. Suitable for line pressures up to pipe flange rating.
4. ANSI Class 125/150 lb flange and bolting dimensions.
5. Size: Match installed line size.
6. Bolt and flange material: Carbon steel.
7. Sensing sleeve material: Buna-N or Butyl based on application.
8. Filling fluid: Glycerin or manufacturers recommended fluid for material compatibility.
9. Manufacturer to assemble, fill, and calibrate associated pressure gauge and switch.

2.6 PRESSURE GAUGE COCKS

A. Manufacturers: Same as for pressure gauges.

B. Provide pressure gauge cocks between pressure gauges and gauge tees on piping system. Construct gauge cock of brass with 1/4 inch female NPT on each end, and "T" handle brass plug.

C. Siphon: ¼ inch straight coil constructed of brass tubing with 1/4 inch male NPT on each end.

D. Snubber: ¼ inch brass bushing with corrosion resistant porous metal disc through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION OF TEMPERATURE GAUGES

A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-½ inches (65 mm) for installation of thermometer sockets. Allow clearance from insulation.

B. Install thermometers in air duct systems on flanges.

C. Locate duct-mounted thermometers minimum 10 feet (3 m) downstream of mixing-dampers, coils, or other devices causing air turbulence.

D. Coil and conceal excess capillary on remote element instruments.

E. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45º off vertical. Adjust to final angle, clean windows and lenses.

3.3 INSTALLATION OF PRESSURE GAUGES AND SWITCHES

A. Process gauges and switches for process systems shall be installed as shown on the detailed Drawings and scheduled.

B. Factory install all process gauges and switches on diaphragm seals as shown on the detailed Drawings.

C. Locations: Install in following locations and elsewhere as indicated:

D. At suction and discharge of each pump.

E. At discharge of each pressure reducing valve.

F. Install gauges in vertical upright position in the position most easily read by observer standing on floor.

G. Do not turn or loosen gauges or switches on sealed systems.

3.4 CLEANING

A. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

3.5 SCHEDULE OF PRESSURE GAUGES, PRESSURE SWITCHES AND SEALS FOR PROCESS SYSTEMS

A. Pressure Gauges:

Location	Range
PI-1-1	0 to 100 PSI

B. Pressure Differential Gauge:
1. Not Required

C. Manometers:
1. Not Required

D. Pressure Switches:
1. Not Required

E. Diaphragm Seals:

Location	Line Size (inches)
PE-1-1	½”

F. Annual Seals:
1. Not Required

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Submit list of wording, symbols, letter size, and color-coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two nameplates, tags, labels (1¼-inch letters) and directional arrows.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations of tagged valves.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Brady (WH) Co., Signmark Div.

B. Other acceptable manufacturers offering equivalent products:

1. Allen Systems, Inc.
2. Industrial Safety Supply Co.
3. Seton Name Plate Corporation.
4. Or equal.

2.2 NAMEPLATES

A. Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Provide identification nameplates bearing the full equipment name and tag number as shown on the Drawings.

2.3 TAGS

A. Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Tag size minimum 1½-inch diameter.

C. Provide identification tags bearing the control valve or instrument tag number as shown on the Drawings. The equipment tag number is shown on the Process & Instrumentation Drawings.

2.4 PIPE MARKERS

A. Self-Sticking Pipe Markers and Arrow Tape:
1. High-gloss, dimensionally stable vinyl film with an acrylic pressure-sensitive adhesive resistant to moisture, oils, solvents, and weathering.
2. Provide labels and arrows as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-946; Seton Nameplate Corporation, New Haven, CT.; or equal.

B. Mechanically Affixed Pipe Markers:
1. Surface protected, pre-printed, pre-coiled, plastic tubes that are either pre-printed or can except the self-sticking pipe markers and arrows applied.
2. Provide mechanically affixed pipe markers as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-915; Seton Nameplate Corporation, New Haven, CT., Snap-On Markers; or equal.

C. Pipe Markers and Arrow Coloring:
1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
2. Standard coloring: Provide labels and arrows with black lettering and on a yellow background, unless noted otherwise on the Drawings Piping Schedule.
3. Provide arrow tape with the same background color as the labels background color, and the same arrow color as the labels lettering color.

D. Label Lettering:

1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
2. All markers must be in compliance with respect to proper letter color, proper letter size, correct background color and proper marker size (length).
3. Provide identification labels bearing the full piping system name as shown on the Drawings. The label name is shown under the "Service" column on the Piping Schedule, Drawing 95-M-1.
4. Provide labels with lettering sized per the requirements of the following lettering height schedule:

LETTERING HEIGHT SCHEDULE

Outside Pipe Diameter (Inch)	Minimum Letter Height (Inch)
¾ - 1¼	½
1½ - 2	¾
2½ - 6	1¼
8 and over	2½

E. Directional Flow Arrows:
1. Provide roll mounted directional flow arrows with the directional arrows printed directly on color- coded banding tape.
2. Supply the directional flow arrows from the same manufacturer that supplies the labels.

2.5 PIPE BANDING

A. Self-Sticking Pipe Banding:
1. High-gloss, dimensionally stable vinyl film with an acrylic pressure-sensitive adhesive resistant to moisture, oils, solvents, and weathering.
2. Provide banding as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-946; Seton Nameplate Corporation, New Haven, CT.; or equal.

B. Mechanically Affixed Pipe Bands:
1. Surface protected, pre-printed, pre-coiled, color-coded plastic tubes.
2. Provide mechanically affixed pipe markers as manufactured by W.H. Brady Company, Milwaukee, WI., Style B-915; Seton Nameplate Corporation, New Haven, CT., Snap-On Markers; or equal.

C. Provide 6-inch wide color bands, color and number as specified hereinafter.

D. Space multiple bands 3/4-inch apart.

E. Band Coloring:
1. All pipe marking will comply with ANSI 13.1 Scheme for the Identification of Piping Systems.
2. Provide pipe band per the requirements of the Drawings. The pipe banding requirements and color is shown under the "Remarks" column on the Piping Schedule, Drawing 95-M-1.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Pipe Labeling:
1. Banding:
a. Apply banding at all connections to equipment, valves, or branch fittings, at wall boundaries and at intervals along the piping not greater than 30 inches on center, with at least one band applied to each exposed run of pipe.
2. Pipe Markers and Directional Arrows:
a. Locate labels at all connections to equipment, valves, or branching fittings, at wall boundaries, and at intervals along the piping not greater than 18 feet on center.
b. Each pipe shall be adequately labeled with a minimum of 2 labels in each room, crawl space or compartment.
c. Locate separate flow directional arrows on each side of pipe marker indicating direction of flow.
d. If flow is bi-directional, use double headed arrows.

B. Equipment Labeling:
1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
2. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
3. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

C. Equipment Labeling:
1. Install tags with corrosion resistant chain.
2. Tag control valves, and instruments.

END OF SECTION

SECTION 15250

PIPE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 REFERENCES

A. American Society for Testing and Materials:
1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
4. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
5. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
7. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
8. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
9. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
10. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
11. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
12. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
13. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
14. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
15. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
16. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
17. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
18. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

19. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
20. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

1.3 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Include product description, list of materials and thickness for each service, and locations.

C. Submit manufacturer's installation instructions under provisions of Division 1.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84 (NFPA 255) and UL 723 method, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, maximum use temperature, including fire hazard indexes of products.

B. Deliver, store, protect and handle products on site under the provisions of Division 1.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect against dirt, water, and chemical and mechanical damage.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15.

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of electric heat tracing, included in Section 16857.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by the manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperatures during and after installation for a minimum period of 24 hours.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Process Piping Insulation:
a. CertainTeed Corporation.
b. Manville Products Corporation.
c. Owens-Corning Fiberglass Corporation.
d. Armstrong
e. Or equal.
2. Mineral-Fiber Insulation:
a. CertainTeed Manson.
b. Knauf FiberGlass GmbH.
c. Owens-Corning Fiberglas Corp.
d. Schuller International, Inc.
e. Flexible Elastomeric Thermal Insulation:
f. Armstrong World Industries, Inc.
g. Rubatex Corp.
3. Cellular Glass Insulation:
a. Pittsburgh Corning
4. Calcium Silicate:
a. Industrial Insulation Group, LLC – Thermo 12 gold

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

D. Cellular Glass Thermal Insulation: Glass material, closed-cell structure. Insulation shall comply with ASTM C552.
1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

E. Calcium Silicate Insulation
1. Rigid Hydrous Calcium Silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs per cu. ft., thermal conductivity of not more than 0.44 at 300ºF, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service of 0ºF to 1200ºF. Material to be visually coded or marked to indicate it is asbestos free.

2.3 JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White or gray.

D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- (0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

E. Aluminum Jackets:
1. Cover piping and insulation with 0.016-inch thick aluminum jacket.

2. Hold jacket in place by a continuous friction type joint, providing a positive weatherproof seal over entire length of jacket.
3. Secure the circumferential joints with preformed snap straps containing weatherproof sealant.
4. Cover outdoor fittings with matching preformed aluminum jackets, two-piece elbows and flange covers, secured with stainless steel bands.
5. Provide fitting covers as manufactured by Childers, Papco, or equal.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:
1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.
2. Aluminum: 0.007 inch (0.18 mm) thick.
3. Nickel-Copper Alloy: 0.005 inch (0.13 mm) thick.

C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
   1. Apply insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
   3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
   a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:
1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 CELLULAR GLASS THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:
1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:
   1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
   2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
   3. Apply insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.7 JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
   1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
   3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
   1. Draw jacket material smooth and tight.
   2. Apply lap or joint strips with the same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

C. Apply PVC jacket where indicated, with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

3.8 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.9 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

3.10 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
   1. Inspect fittings and valves randomly selected by Engineer.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.11 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.12 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic (W1) hot, & cold and Non-potable (W2) which are piped utilizing copper or steel or stainless steel piping. (For W1 and W2 water piped in corrosive areas utilizing Schedule 80 CPVC – no insulation required.)
   1. Operating Temperature: 50 to 140° F (15 to 60° C).
   2. Insulation Material: Mineral fiber.
   3. Insulation Thickness: 1 (one) inch.
   4. Vapor Retarder Required: No.
   5. Jacket:
      a. FSK where piping is concealed;
      b. PVC where piping is exposed (protects insulation from washdown activities).

B. Service: Insulate all process piping indicated on pipe schedule drawing 95-M-1:
   1. Operating Temperature: As Scheduled (2 to 49° C).
   2. Insulation Material: Mineral fiber.
   3. Insulation Thickness:
      a. For pipe sizes up to and including 1-inch: 1-inch minimum.
      b. For all pipe sizes 1-1/4-inch and above: 1.5-inch thick minimum.
   4. Jacket: Foil and Paper.
   5. Vapor Retarder Required: Yes.
   6. Finish: Painted.

C. Service: Emergency generator engine exhaust piping and silencer
   1. Operating Temperature: As Scheduled (1200° F).
   2. Insulation Material: Calcium Silicate
   3. Form: Round or block.
   4. Insulation Thickness: For all pipe sizes: 3-inch thick minimum.

5. Jacket: Aluminum .
6. Vapor Retarder Required: No.
7. Finish: None.

END OF SECTION

SECTION 15500

BASIC HVAC MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes general administrative and procedural requirements for HVAC installations.

1.2 REGULATORY REQUIREMENTS

A. Conform to all state and local code requirements.

B. Obtain permits and request inspections from authority having jurisdiction and pay for all fees incidental thereto.

1.3 DESIGN CONDITIONS

A. Outside Conditions:
1. Winter: -10°F
2. Summer: 89°F, D.B.; 75°F, W.B.

B. Inside Conditions:
1. Winter: Minimum temperatures are all in accordance with requirements of Chapter COMM 63, Wisconsin Administrative Code.

1.4 PROJECT/SITE CONDITIONS

A. Install work in locations shown on drawings, unless prevented by project conditions.

B. Project design is based around the first listed manufacturer in relative specification sections. Subsequent manufacturers listed are also acceptable. However, the use of these manufacturers may result in minor design changes involving equipment layout, supports, etc. The Contractor shall be responsible for such and include any modifications required as part of his bid.

C. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Engineer before proceeding.

1.5 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

1.6 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.7 MECHANICAL INSTALLATIONS

A. Coordinate mechanical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, light fixtures, and other installations.

1.8 CUTTING AND PATCHING

A. This article specifies the cutting and patching of mechanical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.

B. Cutting and patching shall be performed per Division 1 section entitled Cutting and Patching. Where referenced section is not included as part of this specification and as a minimum, the Contractor shall perform cutting and patching as outlined in this article.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. Where changes or removal of existing equipment, devices, etc. takes place. Contractor shall be responsible for restoring surfaces where original equipment devices, etc. were originally located to match existing surrounding surfaces.

F. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
   1. Uncover work to provide for installation of ill-timed work;
   2. Remove and replace defective work;
   3. Remove and replace work not conforming to requirements of the Contract Documents.
   4. Install equipment and materials in existing structures.

H. Cut, remove, and legally dispose of selected mechanical equipment, components, and materials as indicated including, but not limited to, removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new work.

I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

K. Locate, identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

1.9 ELECTRICAL CONNECTIONS

A. Line voltage wiring (115 volts and over) required for the connection of the heating and ventilating equipment to be done by the Electrical Contractor; line voltage temperature control wiring required for the operation of the HVAC system shall be by the Mechanical Contractor per Division 16 requirements, unless shown on the electrical drawings (Division 16). Low voltage wiring required for HVAC equipment or control (below 115 volts) to be done by the Mechanical Contractor.

B. The Mechanical Contractor to furnish necessary controls, wiring diagrams, and instruction sheets, and coordinate his work with that of the Electrical Contractor to assure proper connection and operation of controls and equipment.

C. The Mechanical Contractor to be responsible for the operation of the system, temperature, safety, and other controls on the work during installation and guarantee period including equipment furnished by Owner.

D. Magnetic starters, pushbutton stations, pilot lights, etc. not an integral part of packaged mechanical equipment, to be furnished by the Electrical Contractor, unless otherwise noted.

E. Disconnect switches, fused disconnects, capped safety switches, etc. to be furnished by the Electrical Contractor unless specifically noted to be furnished with the respective equipment item under Division 15. All disconnects whether furnished by HVAC contractor or Electrical Contractor are to be installed by the Electrical Contractor.

F. Electrical connections to be per Division 16 requirements.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Conform with the General Conditions and Division 1.

1.11 PROJECT RECORD DOCUMENTS

A. Conform with the General Conditions and Division 1.

PART 2 PRODUCTS

A. Not Used

PART 3 EXECUTION

A. Not Used

END OF SECTION

SECTION 15515

BASIC HVAC SYSTEM MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Pipe Penetrations
5. Duct Penetrations
6. Mechanical demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS – GENERAL

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS – GENERAL

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a) Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b) Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 PIPE PENETRATIONS – GENERAL

A. Provide steel pipe sleeves with minimum wall thickness of 1/4 inch for pipes passing through beams and walls of concrete, brick, tile, or masonry, and 22 gage galvanized iron sleeves for pipes passing through other parts of construction. Provide steel pipe for all sleeves penetrating floors. Furnish each sleeve having inside diameter 1 inch larger than outside diameter of un-insulated and insulated pipe, unless wall or floor is a firewall, in which case, only the pipe shall penetrate.

B. For pipes passing through floors, walls, and ceilings provide chrome-plated brass escutcheons having outside diameter to cover sleeved openings and inside diameter to fit pipe.

C. Fire and smoke-rated surfaces.
   1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta Foam Products Insta Fire Seal Firestop Foam, Dow Corning Fire Stop System.
   2. UL-listed or tested by an independent testing laboratory, approved by the State or Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be schedule 40 steel pipe with integral water stop unless the fire stop material used includes a sleeve that is an integral part of the rated assembly.

D. Non rated surfaces
   1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor-ceiling plates for covering openings in occupied spaces.
   2. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water stop type wall sleeve.

3. At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to effect the seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

2.5 DUCT PENETRATIONS – GENERAL

A. Fire and smoke-rated surfaces:

1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, Insta Foam Products Insta Fire Seal Firestop Foam, Dow Corning Fire Stop System.
2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be minimum 16 gauge galvanized steel sleeves.

B. Non-rated surfaces. Fiberglass insulation fill at voids with galvanized steel sheet metal bank-off on both sides of duct penetration through walls & ceilings. Use fire resistant sealant for sealing and soundproofing.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Sleeves are required for core-drilled holes; see detail at end of this section.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
   a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a) Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b) Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials.

O. Verify final equipment locations for roughing-in.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS – GENERAL

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions. Coordinate size and placement of concrete bases with the contractor responsible for placement of the concrete.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 15525

SUPPORTS, ANCHORS, SLEEVES, AND SEALING FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors, sleeves, and sealing.

B. Note: Equipment curbs are specified in individual equipment specification sections.

1.2 REFERENCES

A. MSS SP-58 Pipe Hangers and Supports - Materials, Design, and Manufacture

B. MSS SP-59 Pipe Hangers and Supports - Selection and Application

PART 2 - PRODUCTS

2.1 STRUCTURAL SUPPORT

A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support mechanical equipment.

B. Provide support, anchors, and sleeves compatible with atmosphere where located. For applications located in corrosive atmospheres such as chemical rooms or rooms with high moisture, use Stainless Steel version of hanger model and type listed in this Section. All other areas shall use Galvanized Steel.

2.2 PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers: B Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal. Grinnell figure numbers are listed below; equivalent material by other manufacturers is acceptable.

1. <u>Note: All steel pipe supports shall have galvanized finish (Pregalvanized or hot dipped) or as called for in paragraph 2.1, B above.</u>

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Galvanized finish.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.

2. ERICO/Michigan Hanger Co.

3. PHS Industries, Inc.

4. Pipe Shields, Inc.

5. Rilco Manufacturing Company, Inc.

6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Hot Piping. Provide one of the following:

1. Water-repellent treated, ASTM C 533, Type I calcium silicate

2. Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass

3. ASTM C 552, Type II cellular glass.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
   a. B-Line Systems, Inc.; a division of Cooper Industries.
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

B. Floor Support for Pipe Sizes to 4 Inches

1. Insulated and Non Insulated Pipe: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and Galvanized steel support.

2.7 STEEL HANGER RODS

A. Threaded both ends, threaded one end, or continuous threaded, stainless steel finish,

B. Size rods for individual hangers and trapeze support as indicated in the following schedule. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

C. Maximum Load (lbs.)

Maximum Load (lbs.) (650 deg F Maximum Temperature)	Road Diameter (inches)
610	3/8
1130	½
1810	5/8
2710	¾
3770	7/8
4960	1
8000	1-1/4

D. Provide rods complete with adjusting and lock nuts.

2.8 FLASHING

A. Metal Flashing: per Section 07600 - Flashing and Sheet Metal.

B. Lead Flashing: 5 pounds per square foot sheet lead for waterproofing; 1 pound per square foot sheet lead for soundproofing.

C. Flexible Flashing: 47 mil thick sheet compatible with roofing.

D. Caps: Steel, 22-gage minimum; 16 gage at fire resistant elements.

2.9 SLEEVES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 24 gauge (0.70 mm) or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

3. Cast Iron: Cast or fabricated wall pipe equivalent to ductile iron pressure pipe, having plain ends and integral water stop, except where other features are specified.

4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical joint end conforming to AWWA C111 and one plain pipe sleeve end.
   a. Penetrating Pipe Deflection: 5 percent without leakage.
   b. Housing: Ductile iron casting having waterstop and anchor ring, with ductile iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
   c. Pipe Sleeve: AWWA C151, ductile iron pipe.
   d. Housing to Sleeve Gasket: Rubber or neoprene push on type of manufacturer's design.

5. Cast Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

6. Underdeck Clamp: Clamping ring with set screws.

7. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.

8. PVC Plastic Pipe: ASTM D1785, Schedule 40.

9. PE Plastic: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.10 SEALING AND FIRESTOPPING

A. Non-Rated Penetrations

1. Pipe Penetrations Through Below Grade Walls: In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water stop type wall sleeve.

2. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade use urethane caulk in annular space between pipe insulation and sleeve.

3. Duct Penetrations:
   a. Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2 inches. Where existing openings have an annular space larger than 2 inches, the space shall be patched to match existing construction to within 2 inches around the duct.
   b. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4-inch sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

2.11 EQUIPMENT SUPPORT STANDS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

2.13 EQUIPMENT SUPPORT ROOF RAILS

A. Acceptable Manufacturers: The Pate Company or equal.

B. Roof rail equipment supports: 18 ga galvanized steel, unitized construction with integral base plate, continuous welded corner seams, pressure treated wood nailer, counter flashing with screws. Internally reinforced to conform with manufacture's load bearing factors.

C. Provide with standard wood nailer with 1-inch overhang to allow for installation of insulation on vertical support surfaces.

D. Provide Roof Rails with Height dimension of 18" and length as required for equipment being supported.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.

C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

D. Protect insulation at all hanger points.

E. Use Stainless Steel Hangers and Materials in lieu of Galvanized steel hangers in corrosive areas.

F. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

3.2 HANGER AND SUPPORT APPLICATIONS

A. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

B. Use hangers and supports with galvanized, metallic coatings.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.

9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.

11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

F. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

G. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

I. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

9. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

10. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

11. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.3 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Each metal framing system in paragraph below requires calculation and detail.

E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

F. Each fiberglass strut system in first paragraph below requires calculation and detail.

G. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

H. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

I. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

K. Each equipment support in first paragraph below requires calculation and detail.

L. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

M. Install hangers and supports to allow controlled thermal 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.

N. Install lateral bracing with pipe hangers and supports to prevent swaying.

O. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

P. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

R. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. High compressive-strength inserts may permit use of shorter shields or shields with lesser arc span. Edit first subparagraph and associated subparagraph below to suit Project.

4. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

5. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

6. Pipes NPS 8 and Larger: Include wood inserts.

7. Insert Material: Length at least as long as protective shield.

8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.4 GENERAL SUPPORT INSTALLATION

A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall

brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Coordinate hanger and support installation to properly group piping of all trades.

C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint, or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.5 HANGER AND SUPPORT SPACING

A. Place a hanger within 12 inches of each horizontal elbow valve, strainer, or similar piping specialty item.

B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

C. Support riser piping independently of connected horizontal piping.

D. Adjust hangers to obtain the slope specified in the piping section of this specification.

E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Spacing
Steel	1/2" through 1-1/4"	6'-6"
Steel	1-1/2" through 6"	10'-0"
Steel	8" through 12"	14'-0"
Steel	14" and over	20'-0"

3.6 VERTICAL RISER CLAMPS

A. Support vertical piping with clamps secured to the piping and testing on the building structure at each floor.

B. Piping 5 inches and above, of lengths exceeding 30 feet, shall be additionally supported on base elbows secured to the building structure, with flexible supporting hangers provided at top of riser to allow for pipe expansion.

3.7 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.8 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.9 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.10 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.11 FLASHING

A. Provide a flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.12 SLEEVES

A. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated. Grout space between sleeve and structure.

B. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch (6 mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. PVC Pipe Sleeves: For pipes smaller than 6 inches (150 mm).
   b. Steel Pipe Sleeves: For pipes smaller than 6 inches (150 mm).
   c. Steel Sheet Metal Sleeves: For pipes 6 inches (150 mm) and larger that penetrate gypsum board partitions.
   d. Cast Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal".
      1) Seal space outside of sleeve fittings with non-shrink, non-metallic grout.

4. Except for below grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

C. Above Grade, Exterior Wall, and Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25 mm) annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm).

2. Install cast iron wall pipes for sleeves 6 inches (150 mm) and larger.

3. Assemble and install mechanical seals according to manufacturer's printed instructions.

D. Below Grade, Exterior Wall, Pipe Penetrations: Install cast iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25 mm) annular clear space between pipe and sleeve for installation of mechanical seals.

E. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile iron wall penetration system sleeves according to manufacturer's printed installation instructions.

F. Duct Sleeves

1. Duct sleeves are not required in non-rated partitions or floors.

2. Provide sleeve required for fire dampers in fire rate partitions and floors. Reference fire damper details on drawings.

3.13 SEALING

A. Non-Rated Partitions:

1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.

2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetrations in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

3. Duct penetrations through non rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart wash rooms, janitor closets, cart wash rooms, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, and where noted on drawings elsewhere.

END OF SECTION

SECTION 15526

IDENTIFICATION FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Identification of all HVAC products installed under Division 15.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI/ASME: Scheme for the Identification of Piping Systems.

PART 2 - PRODUCTS

2.1 MATERIALS - IDENTIFICATION SYSTEMS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Snap On Plastic Pipe Markers: Manufacturer's standard preprinted, semi rigid snap on, color coded pipe markers, conforming to ASME A13.1

C. Plastic Duct Markers: Manufacturer's standard laminated plastic, color-coded duct markers. Conform to following color code:

1. Green: Cold air.

2. Yellow: Hot air.

3. Yellow/Green: Supply air.

4. Blue: Exhaust, outside, return, and mixed air.

5. For hazardous exhausts, use colors and designs recommended by ASME A13.1

6. Nomenclature: Include following:
   a. Direction of airflow.
   b. Duct service (supply, return, exhaust, etc.).

D. Plastic Equipment Markers: Laminated plastic, color coded equipment markers: Conform to following color code:

1. Green: Cooling equipment and components.

2. Yellow: Heating equipment and components.

3. Yellow/Green: Combination cooling and heating equipment and components.

4. Blue: Equipment and components that do not meet any of the above criteria.

5. For hazardous equipment, use colors and designs recommended by ASME A13.1.

6. Nomenclature: Include following, matching terminology on schedules as closely as possible:
   a. Name and plan number.
   b. Equipment service.

7. Size: Approximately 2½ by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4½ by 6 inches (115 by 150 mm) for equipment.

E. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, letter, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. Where more than one type of mechanical identification is specified for listed application, selection is installer's option, but provide single selection for each product category.

B. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Plastic markers: Install on pipe insulation segment where required for hot non-insulated pipes.

2. Locate pipe markers wherever piping is exposed in finished spaces, equipment rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
   a. Near each valve and control device.
   b. Near each branch, excluding short take offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
   c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
   d. At access doors, manholes, and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced at a maximum of 50 foot (15 m) intervals along each run. Reduce intervals to 25 feet (7.5 m) in congested areas of piping and equipment.

g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.

1. Lettering Size: Minimum ¼ inch (6 mm) high lettering for name of unit where viewing distance is less than 2 feet (0.6 m), ½ inch (13 mm) high for distances up to 6 feet (1.8 m), and proportionately larger lettering for greater distances. Provide secondary lettering 1/2 to ¾ of size of principal lettering.

2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet (15 m).

D. Adjusting: Relocate identifying devices, which become visually blocked by work of this Division or other Divisions.

END OF SECTION

SECTION 15835

ELECTRIC HEATING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric Unit Heaters - Standard

1.2 REGULATORY REQUIREMENTS

A. Conform to applicable code for internal wiring of factory wired equipment.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.4 SEQUENCING AND SCHEDULING

A. Install units (equipment exposed to finished areas) after walls and ceiling are finished and painted. Avoid damage.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS – STANDARD

A. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.

B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material or exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings, as applicable.

C. Cabinet: 18 gage steel with easily removed front panel with integral air outlet and inlet grilles.

D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

F. Motor: Horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Mounting Bracket: Provide with Universal wall or ceiling bracket.

H. Control: Provide integral power disconnect switch and integral thermostat.

I. Provide electric unit heaters with capacities as scheduled or indicated on drawings. Acceptable manufacturers to be: Qmark Type MUH unit heaters, Markel, or TPI.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate final location of unit heaters with other trades.

3.2 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as instructed by the manufacturer.

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts existing surfaces.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heaters as indicated.

C. Hang unit heaters from building structure utilizing mounting brackets. Furnish with heaters. Mount units at height to provide at least 7’6” to 8’-0” of clearance beneath units unless otherwise indicated or directed by Engineer.

D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

3.4 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 15880

AIR DISTRIBUTION

PART 1 GENERAL

1.1 DESCRIPTION

A. Provide ductwork, accessories, dampers, louvers, grilles, and all equipment related to air distribution and exhaust air ventilation as shown on the DRAWINGS.

1.2 WORK INCLUDED IN THIS SECTION

A. Dampers, Volume

B. Dampers, Automatic

C. Louvers

D. Ventilators, Gravity, Roof

E. Installation, Equipment

F. Installation, Ductwork

1.3 DESIGN CONDITIONS

A. The entire sheet metal installation shall be fabricated of prime sheets of galvanized iron, and shall be installed in accordance with the latest editions of the HVAC DUCT CONSTRUCTION STANDARDS as prepared by SMACNA, INC., or as herein specified otherwise. The editions shall serve as a guide for minimum requirements of the installation except as herein specified otherwise. Install the ducts, risers, etc. as indicated on drawings making all necessary changes in cross sections, offsets, etc., whether or not the same is specifically indicated. If ducts cannot be run as shown on the drawings, this contractor is to install the ducts between required points by any path available, subject to the approval of the A/E.

B. All ductwork shall be constructed to the following minimum SMACNA pressure standards:

C. All supply, return, and exhaust ductwork, connected to fans whose total fan design static pressure is less than 1", shall be fabricated to 1" W.G. SMACNA standards. All ductwork shall be sealed to SMACNA Seal Class B. No snap lock seams will be accepted.

D. All supply, return, and exhaust ductwork, connected to fans whose total fan design static pressure is greater than 1", shall be fabricated to 2" W.G. SMACNA standards. All ductwork shall be scaled to SMACNA Seal Class A. No snap lock seams will be accepted.

E. Ductwork shall not be hung or supported from metal roof decking. Provide necessary support from top chord of joist or structural members.

PART 2 PRODUCTS

2.1 DAMPERS, VOLUME

A. Provide dampers, whether indicated or not, in every supply, return, and exhaust branch from main trunk duct fitted with locking devices for adjusting the air delivery.

B. Provide elevated dial regulators for insulated ducts.

2.2 DAMPERS, AUTOMATIC

A. Install automatic outside, return air, and exhaust air dampers, furnished by the Temperature Control Contractor.

B. This Contractor shall install interior baffles to fit the dampers to the duct, and as required to eliminate any air stratification which may occur after the installation.

2.3 LOUVERS

A. Provide 4", 6", Greenheck or Dowco Corporation, extruded aluminum horizontal side drainable, properly reinforced louvers complete with extended or standard aluminum sills, standard heads, and 1/2" mesh aluminum wire screens on inside face of louver. Louvers shall be Model ESD-635; finish to be Kynar Coated.

PART 3 EXECUTION

3.1 INSTALLATION, EQUIPMENT

A. Install in accordance with manufacturer's instructions.

3.2 INSTALLATION, DUCTWORK

A. Seal all low velocity ductwork corner joints with Hard Cast #601 Iron Grip. Cover the corner openings with tape and mastic if the openings are too large to be sealed with mastic only such that the total duct leakage of the system does not exceed 5% of the total design volume. See Design Conditions of this section for duct sealing requirements.

B. Where long sweep fittings cannot be installed, provide SMACNA Approved spilt runner adjustable single thickness blade turning vanes in all square and rectangular elbows and set for the proper angles. Blades shall be 2" apart with 1" extension on leaving air side or as described in SMACNA.

C. Provide 45 degree entry converging tee boot fittings at all straight tap-in connections to the trunk duct where long radius takeoffs cannot be physically installed. Provide conical fittings at round duct takeoffs to trunk duct.

D. This Contractor shall coordinate all work with the air balance and testing agency. Furnish and install all volume dampers in locations required by the agency to adequately balance the system.

E. Increase sizes of ducts lined with sound insulation so free area will correspond to dimensions shown on drawings.

F. Provide copper flashing, or counterflashing, wherever required to make a watertight installation.

G. Sleeves, Openings, Cutting, Patching, and Drilling: See Section 15500.

END OF SECTION

SECTION 15891

DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:

1. Volume dampers.

2. Motorized control dampers & Actuators.

3. Turning vanes.

4. Duct-mounting access doors.

5. Flexible connectors.

6. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Motorized control dampers and damper motors.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide accessories suitable for environment in which they are being installed. Match duct material where applicable, i.e., for stainless steel ductwork, use stainless steel duct accessories.

2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 MOTORIZED CONTROL DAMPERS – PROVIDED AS STAND ALONE NOT PART OF EQUIPMENT PACKAGE.

A. Manufacturers: Subject to “Buy American” Act compliance

1. TAMCO Series 9000 ECT (Insulated w/ thermally broken frame) & Series 1000 (Uninsulated).

2. Arrow Series AFDTI-25LT (Insulated w/ thermally broken frame) & Series ADF-20 (Unsulated)

B. Insulated dampers shall be as follows:

1. Extruded aluminum damper frame shall not be less than .080" thickness. Damper frame to be 4" deep and shall be insulated with polystyrene on three sides if “Installed to Duct” type and on four sides if “Flanged to Duct” type.

2. Blades to be extruded aluminum, internally insulated with non CFC, expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R 2.29 and a temperature index of 55.

3. Blade gaskets shall be Flexible silicon. Frame seals shall be of extruded flexible silicon. Gaskets to be secured in an integral slot within aluminum extrusions.

4. Bearings to be comprised of a clean inner bearing fixed to a 7/16" aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame.

5. Linkage hardware shall be installed in frame side and be constructed of aluminum and corrosion resistant zinc and nickel plated steel, complete with cup point trunnion screws for slip proof grip.

6. Dampers to be designed for operation in temperatures ranging between 40ºF and 212ºF.

7. Damper shall be available with either opposed blade action for modulating control or parallel blade action for basic open/close control. See damper schedule for Action specified.

8. Air leakage through a 48" x 48" damper shall not exceed 4.12 cfm/sq. ft. against 4" w.g. differential static pressure @ standard air leakage data to be certified under the AMCA certified ratings program.

9. Leakage shall not exceed 6.7 cfm/sq. ft. against 4" differential static pressure @ 40ºF.

10. Pressure drop of a fully open 48" x 48" damper shall not exceed .03" w.g. at 1,000 fpm.

11. Dampers shall be made to size required without blanking off free area.

12. Dampers shall be available in two mounting types: (i.e., “Installed in Duct” or “Flanged to Duct”).

13. Installation of dampers shall be in accordance with manufacturer’s installation guidelines.

C. Uninsulated dampers to be as follows:

1. Extruded aluminum damper frame shall not be less than .080” thick. Damper frame to be 4” deep.

2. Blades to be of extruded aluminum profiles.

3. Blade gaskets shall be of extruded EPDM. Frame seals shall be of extruded TPE. Gaskets to be secured in an integral slot within aluminum extrusions.

4. Bearings to be comprised of a celcon inner bearing fixed to a 7/16" stainless steel hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame.

5. Linkage hardware shall be installed in frame side and be constructed of stainless steel, complete with cup point trunnion screws for slip proof grip.

6. Dampers to be designed for operation in temperatures ranging between -40ºF (-40ºC) and 212ºF (100ºC).

7. Dampers shall be available with either opposed blade action for modulating control or parallel blade action for basic open/closed control.

8. Air leakage through a 48" x 48" damper shall not exceed 10.3 CFM/sq. ft. against 4" W.G. differential static pressure @ standard air. Standard air leakage data to be certified under the AMCA certified ratings program.

9. Pressure drop of a fully open 48" x 48" damper shall not exceed .02" W.G. at 1000 FPM.

10. Dampers shall be made to size required without blanking off free area.

11. Dampers shall be available in two mounting types: (i.e., “Installed in Duct” or “Flanged to Duct”).

12. Installation of dampers shall be in accordance with manufacturer’s installation guidelines.

D. Damper motors /actuators

1. Provide damper motors/actuators of the electronic type sized to operate their respective dampers with sufficient reserve power to provide smooth modulation action.

2. Provide damper operators with spring return, which shall return all dampers to their normally open or normally closed positions upon failure of controlling signal. Dampers shall be 120V type with end switches for proof of open and/close.

3. In corrosive areas, provide damper motor enclosure suitable for use in corrosive atmosphere. In Class 1, Division 1 & 2 areas, provide damper motors with enclosures which are both corrosion resistant and explosion proof.

4. Manufacturers: Subject to “Buy American” Act compliance
   a. Belimo Aircontrols, Inc.
   b. Honeywell
   c. Johnson Controls

2.5 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Duro Dyne Corp.
   c. METALAIRE, Inc.
   d. Ward Industries, Inc.

2.6 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:
   a. American Warming and Ventilating.
   b. CESCO Products.
   c. Ductmate Industries, Inc.
   d. Greenheck.
   e. McGill AirFlow Corporation.
   f. Ventfabrics, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:
   a. Less Than 12 Inches Square: Secure with two sash locks.
   b. Up to 18 Inches Square: Two hinges and two sash locks.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.

2. Duro Dyne Corp.

3. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers (powered backdraft dampers) on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers for all diffuser and equipment connections unless noted otherwise.

F. Provide additional balancing dampers that are required to achieve a balanced system but not shown on the drawings. Install balancing dampers a minimum of two duct widths from branch takeoff.

G. Provide test holes at fan inlets and outlets and elsewhere as indicated.

H. Air blender installation shall be in accordance with the manufacturer’s written installation instructions and SMACNA plenum construction guidelines. If necessary,

provide reinforcement in plenum where the mixing device is installed to eliminate excess vibration or deflection of blank off plenum.

I. Install fire dampers, with fusible links, according to manufacturer's UL-approved written instructions.

J. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.

2. Downstream from volume dampers, turning vanes, and equipment.

3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.

4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.

5. On sides of ducts where adequate clearance is available.

K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

L. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15936

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Registers/grilles.

2. Louvers.

1.2 REFERENCES

A. National Fire Protection Association (NFPA):

1. NFPA 90A Installation of Air Conditioning and Ventilating Systems.

B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. SMACNA Low Pressure Duct Construction Standard.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the Section 01300.

1.4 REGULATORY REQUIREMENTS

A. Conform to NFPA 90A.

PART 2 - PRODUCTS

2.1 CONTRACTOR FABRICATED – PLAN DESIGNATION “A”

A. Stainless steel screen – 1” x 1” size fabricated with minimum 1-1/4” stainless steel borders.

B. Contractor option to utilize a manufactured equivalent. Requires pre-approval.

2.2 LOUVERS

A. Standard Louvers

1. Provide 4-inch deep louvers with K style drainable blades on 37 deg & 45 deg angles, heavy channel frame, birdscreen with ¾ inch screen.

2. Fabricate of 0.081" thick extruded 6063T5 aluminum alloy, welded assembly.

3. Finish: “Kynar” - Organic Coating * Architectural-grade, factory-applied organic coating, 70% PVDF Resin, with chrome phosphate pretreatment. Comply with AAMA 2605-98. Final “custom color” selection by Owner/Architect.

4. Provide louvers with Extended Sill

5. Provide louvers of sizes as indicated on plans.

6. Acceptable Manufacturers: Greenheck ESK-402, or Ruskin Equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install grilles to ductwork with airtight connection.

D. Provide balancing dampers on duct take-off to grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. For all “Occupied Buildings” Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 15950

AUTOMATIC TEMPERATURE CONTROL WORK

PART 1 GENERAL

1.1 DESCRIPTION

A. Provide Johnson Controls, Inc., Automated Logic, Inc., or Honeywell, Inc. pneumatic system or direct digital control system (DDC) of temperature control in accordance with the Bid Documents and installed by equipment manufacturer.

1.2 WORK INCLUDED IN THIS SECTION

A. Wiring

B. Thermostats

C. Receiver Controllers

D. Transmitters

E. Control Cabinet Enclosures

F. Automatic Dampers and Operators

G. PRV-1 Control Sequence

H. Electric Unit Heater Sequence

I. Testing, Adjusting, and Balancing Coordination

1.3 SUBMITTALS

A. Shop Drawings: Submit under the provisions of Division 1, including the following:
   1. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
   2. Shop drawings for each electric control system, containing the following information:
      a. Schemtic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
      b. Label each control device with setting or adjustable range of control.
      c. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
      d. Provide details of faces of control panels, including controls, instruments, and labeling.

e. Include verbal description of sequence of operation.

B. Submit operation and maintenance manuals under provisions of Division 1.

C. Submit certificates of proper installation and operator training under provisions of Divisions 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle the equipment under the provisions of Division 1.

PART 2 PRODUCTS

2.1 WIRING

A. See Section 15500.

2.2 THERMOSTATS

A. All room thermostats shall be electric/electronic, relay, fully proportioning type with adjustable sensitivity. Verify all thermostat locations with the owner before completing the installations.

2.3 RECEIVER CONTROLLERS

A. All remote mounted receiver controllers shall be fully proportioning with adjustable sensitivity. Remote readjustable instruments shall have an adjustable ratio. Each controller shall be provided with a permanently connected means for indicating the exact point within the modulating range of which the controller is operating.

2.4 TRANSMITTERS

A. All transmitters shall be capable of measuring the space or duct temperature and transmitting a pneumatic or electric signal directly proportional to the temperature. The range of the transmitter shall be 50°F or, when required, a wider range of 100°F. Each transmission system, consisting of transmitter and receiver combined shall have an accuracy of 1% of scale range. All transmitters shall be located at the point of measurement. All air sensors shall be equipped with 8' averaging bulbs.

2.5 CONTROL CABINET ENCLOSURES

A. All control cabinets shall be constructed with extruded aluminum alloy frames. All corners shall be securely riveted and supported by internal angle brackets. Internal butt joints around the door shall provide a 1/2" overlap seal around the cabinet frame. The cabinet shall have a removable face and back panel. The panels shall be made of aluminum bonded on both sides of plywood core. The face panel shall be held in place with continuous solid retaining bars. The panel hinges shall be run the entire height of the panel. All cabinets shall be Underwriters' Laboratories, Inc. listed for line voltage applications.

2.6 AUTOMATIC DAMPERS AND OPERATORS

A. Provide automatic dampers and operators as shown or indicated on drawings. Dampers shall be factory fabricated balanced type with formed double thickness galvanized steel or aluminum blades, with factory assembled linkages mounted in galvanized steel or aluminum frames. Blades shall have interlocking edges with compressible seals at the point of contact on both blade edges and ends. Rectangular dampers, 6" or more in a direction perpendicular to the axis, shall be louvered. Blades on louvered dampers must not be over 6" wide. Dampers shall not be more than 48" in length between bearings. Modulating dampers shall be of the opposed blade type. Two position dampers shall be parallel type.

B. Dampers, when closed, shall be guaranteed by the manufacturer not to leak air in excess of 1/2% (based on 2000 FPM approach velocity and 4" W.G. static pressure).

C. All dampers shall be sized by the control manufacturer in accordance with his recommendations. Any necessary blank-off plates or transitions, required to facilitate the standard size, shall be provided by the Sheet Metal Contractor.

PART 3 EXECUTION

3.1 PRV-1 CONTROL SEQUENCE

A. PRV-1 to be started and stopped by means of a reverse acting thermostat. PRV-1 shall start when outside air automatic damper is fully open. Provide a manual override switch next to thermostat to allow for a manual operation of PRV-1 and automatic damper.

3.2 ELECTRIC UNIT HEATER SEQUENCE

A. EUH-01 and EUH-02 are to be controlled by means of integral thermostats furnished by unit heater manufacturer. This Contractor shall provide an adjustable outside air sensor to lock out unit heater operation above 65°F (adjustable).

3.3 TESTING, ADJUSTING, AND BALANCING COORDINATION

A. This Contractor shall assist the Balancing Agency by completing all control work as follows:

B. Verify that all control components are installed in accordance with project requirements and are functional.

C. Verify that all controlling instruments are calibrated and set for design operating conditions.

D. Calibrate room thermostats after installation, and before the thermostat control verification tests are performed. The balancing agency shall prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

E. Allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components.

END OF SECTION

SECTION 15971

HVAC ELECTRIC CONTROL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electric HVAC control systems work required by this section is indicated on drawings and schedules, by requirements of this section, related sections.

1. Control system components

2. Control sequences are specified in this section.

B. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels. All control wiring to be routed in conduit and shall comply with Division 16 requirements. Coordinate with Division 16 Requirements.

2. Power supply wiring for power source to power connection on controls and/or unit control panels unless shown on electrical drawings.

3. Interlock wiring between electrically operated equipment units; and between equipment and field-installed control devices unless shown on electrical drawings.

1.2 RELATED SECTIONS

A. Control dampers and damper actuators are specified in Section 15891 – Duct Accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms specializing and experienced in electric control system installations for not less than 5 years.

C. Codes and Standards:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFA 90A "Standard for the installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.4 SUBMITTALS

A. Product Data

1. Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

B. Shop Drawings

1. Submit shop drawings for each HVAC electric control system:
   a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and control devices.
   b. Clearly show work installed under this section and tie-ins and control supplied/furnished by Process Instrumentation & Controls Contractor.
   c. Label each control device with setting or adjustable range of control.
   d. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   e. Provide details of faces of control panels, including controls, instruments, and labeling.
   f. Include verbal description of sequence of operation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Component manufacturer shall be generally as listed below:
   a. Siemens
   b. Johnson Controls
   c. Honeywell
   d. Landis Staefa

2. Some individual component manufacturers may vary. These may be listed separately with the component descriptions.

2.2 MATERIALS AND EQUIPMENT

A. General

1. Provide electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, sensors, controllers, and other components as required for a complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric control systems with following functional and construction features as indicated.

2. Corrosive Environments: Provide electric control systems suitable for corrosive environments. Coordinate these with other work in the associated areas and with Division 16 work. Use proper NEMA rated panels, boxes, devices, etc., & utilize proper materials.

B. Remote-Bulb Thermostats: Provide remote-bulb thermostats of on-off, or modulating type, or reverse acting as required by sequence of operation. Provide liquid-filled units designed to compensate for changes in ambient temperature at instrument case. Provide capillary and bulb of copper or stainless (corrosion resistant where required). Equip bulbs in water lines with separate wells of same material as bulb. Support and protect capillary & bulbs by installing in thru conduit.

1. Provide scale settings and differential settings where applicable, which are clearly visible and adjustable from front of instrument.

2. Equip on-off remote-bulb thermostats with precision snap switches, and with electrical rating as required by application.

3. Provide single stage or two stage remote bulb thermostats as needed in order to provide the necessary controls required by the written sequences outlined in this section.

4. Provide modulating remote-bulb thermostats of potentiometer type constructed so that complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

2.3 SENSORS

A. Electronic Sensors General: Provide electronic temperature sensors of supersensitive resistance type, which are vibration and corrosion-resistant, and of wall mounted immersion, duct mounting, averaging or bulb type as required for application.

B. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

1. Thermistor temperature sensors as follows:
   a. Accuracy: Plus or minus 0.5 deg F at calibration point.
   b. Wire: Twisted, shielded-pair cable.

c. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
d. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.

3. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

C. Electric Contactors

1. Provide contactors for operating or limit-control of electric heating loads, which are UL-listed for 100,000 cycles of resistive loads. Equip with replaceable molded coils and replaceable silver cadmium oxide contacts. Coat core laminations with heat-resistant inorganic film to reduce core losses. Provide line and load terminals on contactors with higher-than-35-amp rating, or provide one-piece formed-and–welded pressure type. Provide screw-type contactors for 35-amp-or-lower rating. Equip field-mounted contactors with suitable steel enclosures; and provide open-type mounting for those installed in factory-fabricated panels.

D. Local Control Panels

1. Provide control panels with suitable brackets for either wall or floor mounting and proper NEMA rating for location, for each supply fan and miscellaneous control system. Panels must conform to Division 16 Requirements. Locate panel adjacent to systems served.
a. Match NEMA rating and material of panel construction with panels provided by Division 16 work in each space. Coordinate with Division 16 contractor.
b. Utilize minimally sized panels for application. Overly large panels with large amount of empty space will be rejected and will require the contractor to replace with acceptable size.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 SEQUENCE OF OPERATION

A. Lift Station

1. Valve Room – 101

a. Electric unit heater EUH-01 to be controlled by respective integral thermostat. On a call for heat, the respective unit is to cycle on to heat the space. When the space heating requirements are satisfied, the respective unit is to cycle off.

2. Generator Room – 102
   a. Electric unit heater EUH-02 to be controlled by integral thermostat. On a call for heat, the unit is to cycle on to heat the space. When the space heating requirements are satisfied, the unit is to cycle off.
   b. Motorized Damper 30-D-01 at Louver 30-L-01 & Damper 30-D-02 at Louver 30-L-02 to be controlled by "ON-OFF-AUTO" switch with reverse acting thermostat. Note: Damper motors 30-D-01 & 02 should be configured to "Power close" and "Spring Open".
      1) In the "ON" position, damper 30-D-01 & 02 to open.
      2) In the "OFF" position, damper 30-D-01 & 02 to close.
      3) In the "AUTO" position, damper to be controlled by a reverse acting thermostat with remote sensing bulb at room ceiling. Thermostat setpoint at 80ºF (adjustable). When temperature is above setpoint, damper 30-D-01 & 02 to open. When the temperature is below setpoint, damper 30-D-01 & 02 to close.
   c. Damper 30-D-01 & 30-D-02 to be interlocked to emergency generator control. This interlock operation shall override any control listed above. When the emergency generator engages, the dampers are to open. When the generator is off, the dampers are to be closed. Coordinate interlock with emergency generator supplier.

3.3 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

A. General

1. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications. Mount controllers at convenient locations and heights. Provide working HVAC control system utilizing industry standard electric control devices and as specified. Finished Controls shall operate HVAC equipment as Control sequences call for.

2. Install local control panels for equipment as listed and install per Divion 16 requirements.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten

flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system. Also label all remote control devices with identification consistent with shop drawing and maintenance manuals.

E. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.

F. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers, and damper motors to unit manufacturer for mounting and wiring at factory.

G. Provide accessories such as mounting brackets, fasteners, supports, etc. which are compatible with environment where devices will be located. In corrosive environments use stainless steel materials.

H. Provide electrical contactors for automatic operation of equipment where needed when magnetic starters are not furnished as part of the design.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16

B. Install building wire and cable according to Division 16

C. Install signal and communication cable according to Division 16

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway.

3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and electrical connections.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.

3. Calibration test electric controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.

2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.

3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.6 ADJUSTING AND CLEANING

A. Start-UP

1. Start-up, test, and adjust electric control systems in presence of manufacturer’s authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning

1. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

C. Final Adjustment

1. After completion of installation, adjust thermostats, control valves, motors, and similar equipment provided as work of this section, verify control sequence operation. Provide verification documentation.

a. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.7 CLOSEOUT PROCEDURES

A. Owner's Instructions

1. Provide services of manufacturer's technical representative for two separate 4-hour days to instruct Owner's personnel in operation and maintenance of electric control systems. The first training session shall be an initial overview with enough information for the Owner to understand the functionality, adjustment capability, etc. A subsequent follow-up training session is to take place with the owner after the owner has spent time using the controls and has a chance to develop additional questions, etc…

2. Schedule instruction with Owner; provide at least 7-day notice to Contractor and Engineer of initial training date. The follow-up training date shall be coordinated with the Owner.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern Work under this Section.

1.2 DEFINITIONS

A. The Owner: The Village of Grafton.

B. The Engineer: Applied Technologies, Inc., Brookfield, Wisconsin.

C. Provide: Furnish, install and wire complete and ready for service.

D. Exposed: Exposed to view in any room, corridor or stairway.

E. Code: National, State and Local Electrical codes including OSHA requirements.

F. NEC: National Electrical Code

G. NFPA: Standard for Fire Protection in Wastewater Treatment and Collection Facilities

H. Signal Voltage: NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.

I. Low Voltage: 50 to 600 volts

J. Medium Voltage: 601 to 35,000 volts

K. High Voltage: 35,001 volts and greater

1.3 STANDARDS AND CODES

A. All work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. National Codes include, but are not limited to, the NEC and NFPA 820. Comply with all applicable OSHA regulations.

B. All materials shall have a UL or ETL label where a UL or ETL Standard and/or test exists.

1.4 DIMENSIONS AND DEFINITE LOCATIONS

A. The drawings depicting electric work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact location of such equipment and devices shall be established in the field in accordance with

instructions from the Engineer and/or as established by manufacturer's installation drawings and details.

B. The Contractor shall refer to shop drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.

C. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject to measurements of adjacent and previously completed work. All measurements shall be performed prior to the actual installation of equipment.

1.5 DRAWINGS

A. The Contractor shall keep a detailed up-to-date record, of the manner and location in which all installations are actually made, indexing each feeder, pull box and protective device.

B. As Built Drawings - See General Requirements - Division 1.

C. In the event of a conflict between the drawings and specifications, Contractor shall base their bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by an addendum.

1.6 SHOP DRAWINGS AND EQUIPMENT BROCHURES

A. Submit to Engineer for review, the manufacturer's shop drawings and/or equipment brochures in accordance with Division 1 for the following:
1. Section 16140 - Wiring Devices
2. Section 16170 - Motor and Circuit Disconnects (Include disconnect overcurrent devices with this submittal)
3. Section 16421 – Surge Protective Devices
4. Section 16450 – Ground rod locations and measured resistance
5. Section 16461 – Low voltage dry type transformers
6. Section 16470 - Electrical Panelboards (Include panelboard overcurrent devices with this submittal)
7. Section 16475 – Low Voltage Overcurrent Protective Devices
8. Section 16481 - Motor Starters
9. Section 16483 – Adjustable Frequency Drives
10. Section 16510 - Lighting Fixtures
11. Section 16620 - Standby Power Generator
12. Section 16621 - Automatic Transfer Equipment
13. Section 16932 - Occupancy Sensors

B. Plans - Lighting Control Contactors, Lighting Control Time Clocks, Lighting Control Photocells

C. Shop drawings shall be submitted in advance of construction and installation so as to not cause delay in other Contractor's work.

1.7 TESTS AND ACCEPTANCE

A. The operation of the equipment and electrical systems does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

B. After the work is completed and prior to acceptance, the Contractor shall conduct the following tests, tabulate data, date, sign and submit to the Engineer:
   1. Standard megger insulation test on each feeder.
   2. Ground resistance test.
   3. Clamp ammeter test on each feeder conductor with all utilization equipment energized. The load current in each phase conductor of the feeder or the portion thereof supplying the panel shall not differ from the average connected load currents in the feeder conductors by more than 7½%. If the load current does differ by more than 7½%, the Contractor shall change phase loading to same or receive written approval from the Engineer that this is not required due to the nature of the load.

C. Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction. The Contractor shall demonstrate that all work is complete and in perfect operating condition, with race way and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects.

D. In the presence of the Engineer and the Owner, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

E. Perform other tests as specifically directed in other sections of the specification for specific equipment.

1.8 IDENTIFICATION

A. Each distribution and lighting panel shall be equipped with a typewritten directory describing the loads served. Directory shall be contained in a steel frame mounted on the inside face of the panel's door and shall be covered with a sheet of clear plastic.

B. All distribution panels, transformers, motor control centers, transfer switches, panels and cabinets shall be provided with 1/8" minimum thickness 5 ply lamecoid plastic nameplates indicating usage, plan designation and voltage where applicable. This identification may be on the exterior of the unit. Nameplates shall be white with black engraved lettering. Lettering shall be ½" high minimum. Fasten nameplates with escutcheon pins.

C. All panelboards, control panels, and motor control centers shall include a warning label indicating the risk of Arc Flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

D. Junction and pull boxes shall be stencilled as follows:
   1. Lighting and power feeders and branch circuits - 120, 208, 240, 277, and 480V.

2. Instrumentation & Control - I&C

E. Branch wiring shall be color coded per industry standards. Where wires of different systems junction in a common box each cable shall be grouped with its own system and identified using tags or identification strips.

F. On all 3 phase systems, each phase shall be identified at all terminals using code marker.

G. All cover plates for control stations controlling remote equipment shall be engraved to identify the device being controlled.

H. All motor starters, remote control stations, etc., shall be identified with engraved lamecoid nameplates fastened to the equipment with escutcheon pins. Nameplates shall be 1/8" 5 ply lamecoid with 1/2" black letters on a white background. Adhesive cloth labels, similar to those manufactured by Brady Label Co., may be used on motor switches and controls only, indicating the number, designation, size and usage of the motor.

I. Refer to individual specification sections for more specific or additional identification requirements.

1.9 ACCESS PANELS

A. All access panels required by code or otherwise to electrical service equipment shall be supplied and installed by the Contractor.

1.10 CORROSIVE AREAS

A. Refer to drawings for areas that are designated corrosive.

1.11 HAZARDOUS AREAS

A. NFPA 820 identified NEC-Area Electrical classifications. The Contractor shall provide material and installation in compliance with this national standard.

B. All sanitary sumps and wastewater wet wells have a CLASS 1, DIVISION 1 area rating. Contractor shall provide material and installation labor accordingly.

1.12 FIRESTOPPING

A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300-21 and in accordance with the Wisconsin Administrative Code, Department of Commerce Chapter 51.049. The fire rating of the protective seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the construction is maintained.

B. Firestopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent wrap strips mastics, and firestop pillows. All materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by that agency.

C. Materials using solvents or those requiring hazardous waste disposal shall not be used.

D. All wall or floor penetrations openings shall be as small as possible.

E. All openings and annular spaces required by code to be protected, shall be protected whether specifically indicated on the plans or not.

F. The firestop assemblies shall meet ASTM E-814 and all of the fire test and hose stream test requirements of an independent testing agency.

G. Installation of materials and assemblies shall be in strict accordance with the manufacturer's instructions.

H. Acceptable Manufacturers
   1. 3M Corporation.
   2. Nelson Firestop Products
   3. Rectorseal Corporation

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

A. Not used.

END OF SECTION

SECTION 16011

ELECTRICAL STUDIES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. The contractor shall retain the services of an independent third party firm to perform a short circuit, study, a protective device coordination study, and arc flash study.

B. The studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

C. The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

D. The firm should be experienced in low, and medium, voltage power system evaluations. The studies shall be performed, stamped and signed by a registered professional engineer in the State of Wisconsin. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Engineer for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

E. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.3 DATA COLLECTION FOR THE STUDIES

A. The contractor shall collect and provide the required data for preparation of the studies. The Engineer performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. The Contractor is warned against the use of default generic device/equipment values that are available from the analysis software. Instead, the Contractor's study shall use project-specific device data.

1.4 SUBMITTALS

A. Third party qualifications. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies.

B. Draft report. Submit a draft of the study to Engineer for review prior to delivery of the study to the Owner.

C. Final study report.
1. Make all additions or changes as required by the reviewer.
2. Provide studies in conjunction with equipment submittals to verify equipment ratings required.
3. The results of the power system study shall be summarized in final reports. Six (6) bound sets of the final report shall be submitted.

D. The report shall include the following sections:
1. Field study findings.
2. Descriptions, purpose, and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
5. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
6. Print-out of the Arc-Flash labels to be applied to all equipment identified by NFPA-70E. .

1.5 POWER COMPANY APPROVAL

A. Where required, copies of the final report shall be submitted to the power company for their review and Approved copies of the report shall be submitted to the Design Engineer.

1.6 QUALITY ASSURANCE

A. Reference standards listed in the IEEE "Buff Book", latest edition.

B. Reference the equipment requiring Arc-Flash labeling in Article 400 of NFPA-70E.

C. The short circuit study shall be performed with the aid of a computer program and shall be In accordance with the latest applicable IEEE and ANSI standards.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 SHORT CIRCUIT STUDY AND PROTECTIVE DEVICE COORDINATION STUDY

A. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, low voltage switchgear lineup, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.

B. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

C. Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

D. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

E. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.

F. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on Drawing one-lines.

G. Utilize equipment load data for the study obtained by the Contractor from Contract Documents, including Contract Addendums issued prior to bid openings.

H. Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not property rated for fault conditions.

I. Include phase and ground coordination of the standby generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

3.2 ARC FLASH HAZARD ANALYSIS/STUDY

A. The arc flash hazard analysis shall be performed to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system where work could be performed on energized parts.

C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.

F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

H. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

I. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy to the corresponding location.

J. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

K. The Contractor shall affix each Arc-Flash label to the appropriate equipment, following approval of the ELECTRICAL STUDIES submittal.

3.3 ELECTRICAL STUDIES OUTLINE:

Table of Contents for Wastewater Treatment Facility:

I. Overview
II. Short Circuit Study
- SC-1. Purpose
- SC-2. Explanation of Data
- SC-3. Assumption(s)
- SC-4. Analysis of Results
- SC-5. Recommendations
- SC-6. Fault Analysis Input Report
- SC-7. Fault contribution Complete Report
  - Lift Station Normal Operation (Generator Off)
  - Lift Station Emergency Operation (Generator On)

III. Protective Device Coordination Study
- PDC-1. Purpose
- PDC-2. Explanation of Data
- PDC-3. Assumption(s)
- PDC-4. Analysis of Results
- PDC-5. Recommendations

PDC-6. Results – Existing
PDC-7. Results – With All Recommendations
PDC-8. Example Station

IV. Arc Flash Hazard Study
ARC-1. Purpose
ARC-2. Explanation of Data
ARC-3. Assumption(s)
ARC-4. Analysis of Results
ARC-5. Recommendations
ARC-6. Arc Flash Evaluation Report – Existing
- Lift Station Normal Operation (Generator Off)
- Lift Station Emergency Operation (Generator On)
ARC-7. Arc Flash Evaluation Report – With All Recommendations
ARC-8. Print-out of all Arc-Flash Labels

V. Prioritized Recommendations and Calculations

VI. Appendices
APP-1 Input Data (collected from devices and equipment)
APP-2. One-Line Diagram – Existing
APP-3. One-Line Diagram – With All Recommendations
APP-4. One-Line Diagram
APP-5. Protective Device Summaries – Existing
APP-6. Protective Device Summaries – With All Recommendations

3.4 FIELD SETTINGS AND IMPLEMENTATION OF APPROVED REPORT

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device evaluation study, and protective device coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

C. The Arc-Flash labels shall be applied to each piece of equipment.

END OF SECTION

SECTION 16111

CONDUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit systems for all power, control, and communications systems wiring as specified. Flexible, modular wiring systems shall not be used unless expressly accepted by the Engineer.

1.3 QUALITY ASSURANCE

A. National Electrical Contractor's Association (NECA) Standard of Installation.

B. National Electrical Code (NEC) Including State of Wisconsin and local supplements.

PART 2 PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC)

A. Manufactured lengths, full weight, heavy wall, rigid steel conduit, protected inside and out by hot-dipped galvanized or electro-galvanized coating.

B. Minimum conduit size shall be 3/4 inch.

2.2 POLYVINYL CHLORIDE CONDUIT (PVC)

A. Standard lengths and sizes.

B. Minimum size 3/4" with the exception that the minimum size conduit for underground site lighting circuits shall be 1".

C. Schedule 40 or 80, heavy wall rigid plastic (PVC) conduit manufactured to NEMA TC-2 standards, UL listed, and as required by NEC. Sunlight resistant.

D. Rated for 90 degrees C. cable.

2.3 PVC COATED RIGID METAL CONDUIT

A. Per NEMA Standards Publication No. RN 1 - 1980 and ANSI C80.1. Shall be ETL Verified PVC-001 or shall meet UL Adhesion Test per ASTM B 117-94.

B. Rigid steel galvanized conduit with PVC coating.

C. Full weight 40 mil thick PVC coating, bonding to galvanized metal shall be stronger than plastic tensile strength.

D. Minimum conduit diameter shall be 3/4 inch.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Galvanized spiral strip flexible steel.

B. Standard conduit sizes.

C. Heavy wall sunlight resistant PVC jacket.

D. Minimum size 3/4 inch.

PART 3 EXECUTION

3.1 GENERAL

A. Interior conduits for wiring systems rated 50 to 600 volts shall be galvanized rigid conduit (GRC). Exceptions to the requirements stated above are as follows:
1. Conduits for feeder conductors shall be GRC regardless of conduit size.
2. Conduits in poured concrete construction shall be GRC regardless of size.
3. Flexible conduit where required by other paragraphs in this section.
4. Conduits in hazardous locations.
5. Conduits in corrosive areas.

B. Exterior underground conduit in direct contact with the earth and conduits embedded in concrete lighting fixture pole bases shall be heavy wall schedule 40 PVC except as follows:
1. Underground conduit runs which enter or exit the building envelope shall utilize PVC-coated rigid metal conduit from the point of penetration of the building envelope and the next 5' portion of the run in direct contact with the earth.
2. Underground conduit runs which contain adjustable frequency drive conductors shall be PVC-coated rigid metal.

C. Exterior exposed conduit (i.e. outside of building wall or above roof) shall be GRC.

D. Conduits installed in corrosive areas shall be PVC coated rigid metal conduit. Corrosive areas are identified on the drawings.

E. Conduits containing only electrical service bare copper grounding conductors shall be HW PVC.

3.2 DIRECT BURIED UNDERGROUND CONDUIT

A. Exterior underground direct buried conduits shall be buried at a depth of not less than 30 inches below grade.

B. Provide conduits or ducts terminating below grade with means to prevent entry of dirt or moisture.

C. Underground conduits shall slope 1/8" per foot for proper drainage. Conduits shall drain toward manholes and junction boxes, not the electrical equipment.

3.3 PROCEDURES AND PRACTICES

A. Where allowed, the general installation requirements are as follows:
   1. Raceways shall be routed horizontally along the corners of walls and ceilings, directly above edges of base molding at floors, or along the tops of window and door frames.
   2. Raceways shall be routed vertically along corners of adjacent walls and along the edges of window and door frames.
   3. Raceways shall not be routed down or across open wall surfaces except in portions of runs not exceeding 12" in length.
   4. Raceways shall be painted to match wall finishes, in finished spaces.
   5. Fittings and boxes used with raceways shall be specifically designed and approved for use with the raceways.
   6. Raceways may not be routed on or across finished floors.

B. Cut joints shall be square, reamed smooth, and drawn up tight.

C. Keep conduit plugged, clean, and dry during construction.

D. Install No. 12 pull wire in empty conduit.

E. Cap spare conduits.

F. Provide riser clamps around all conduits 1-1/4" or larger that are routed between floors.

G. Provide a watertight conduit system where installed in wet locations such as outdoors, underground, in wash-down areas, or where embedded in concrete.

H. For interior overhead conduit runs, the conduit shall be attached directly to the ceiling (conduit shall not be suspended from the ceiling at a lower elevation).

I. Conduits may be routed exposed in mechanical equipment, electrical, and utility rooms.

J. Route all conduits (including conduits routed above ceilings) parallel to or at right angles with lines of the building construction and structural members except conduit runs routed concealed in poured-in-place concrete floor slabs may be run in a direct line from source to load.

K. Make bends and offsets without kinking or destroying smooth bore of conduit. Arrange bends and offsets in parallel conduits to present a neat symmetrical appearance.

L. Secure conduits in place with malleable corrosion-proof alloy straps or hangers. Conduit straps used in corrosive areas shall be PVC coated.

M. The use of perforated strapping as a conduit hanging method is not approved.

N. Conduit runs that extend through areas of different temperature or atmospheric conditions shall be sealed using approved seal off devices, drained, and installed in a manner that will prevent drainage of moisture or gas migration into cabinets, and equipment enclosures.

O. Conduits routed within poured concrete construction poured walls, floor slabs, topping slabs, etc.) shall comply with the following requirement.

1. Conduits shall be parallel to each other, spaced on center to center distance of at least three times conduit trade diameter, and provided with a minimum of 2 inches concrete covering. Contractor shall note that precast planks below topping slabs may camber. Topping slab thickness will be less at the high point of the camber.
2. Conduits larger than 1¼ inches ID shall not be installed in floor slabs. Conduits over 3/4 inches ID shall not be installed in topping slabs.
3. Conduits embedded in a structural frame slab shall comply with applicable provisions of American Concrete Institute (ACI), Standard 318. Refer to structural drawings for locations of structural frames.
4. Conduits used for feeders shall not be embedded in concrete floor slabs or concrete topping slabs.
5. Conduits in poured concrete construction shall not cross other conduits or other piping.
6. Unless specifically indicated on the electrical plans, conduits installed in (or under) the poured concrete construction shall be approved by the Engineer prior to conduit installation. The contractor will be required to submit drawings showing conduit sizes and routings to the Engineer for his review. Approval may not be given prior to bidding. Contractors who base their bid on the assumption that conduits will be allowed in concrete construction do so at their own risk. No changes will be made to the contract if, during construction, the Engineer prohibits the installation of conduit in concrete construction.

P. In areas constructed of precast concrete conduits may be run in cores of planks.

Q. Connections to Motors and Equipment Subject to Vibration:

1. Flexible steel conduit not over 3 ft. long for connection to motorized equipment.
2. Liquid-tight flexible conduit not over 3 ft. long where exposed to moisture, dirt, fumes, oil, corrosive atmosphere, with connectors to assure a liquid-tight, permanently grounded connection. Locate so it is least subject to physical abuse. Corrosive areas are identified on the floor plans.
3. Use double locknuts and insulated bushings with threads fully engaged.

R. Install bushings with ground lugs and integral plastic lining, at equipment with open bottom conduit entrances.

S. Install conduit expansion fittings where conduits cross expansion joints.

3.4 FIRESTOPPING

A. Provide firestopping at conduit penetrations through fire rated construction in accordance with section 16010.

3.5 CUTTING AND PATCHING

A. Provisions for openings, holes, and clearances through walls, floors, ceilings, and partitions shall be made in advance of construction.

B. Provide cutting, patching and painting necessary for the installation of electrical systems.

C. Where conduits need to penetrate concrete or masonry construction the contractor shall install 22 gauge galvanized steel pipe sleeves, 1 in. larger in diameter than the conduit being installed. Sleeves shall extend 2" above and below the floor slab or wall penetrated. Install sleeves before walls and/or slabs are poured or constructed.

D. The contractor shall prepare drawings indicating size and location of all anticipated floor sleeves for the installation of electrical conduits. Such drawings shall be made available 10 days prior to any scheduled concrete work.

3.6 RESTRICTIONS

A. Conduits routed parallel to steam lines, hot water pipes, flues, high temperature piping or ducts shall be routed at least 12" from such and shall be a minimum 12" clear when crossing same.

B. Do not route conduit over boiler, incinerator, or other high temperature equipment.

C. Where conduits must cross or follow the same path as water, steam or other fluid piping, run electrical conduits above such piping wherever possible.

3.7 ADJUSTMENT AND CLEANING

A. Restore damaged areas on PVC jacketed, rigid conduit with spray type touch-up coating compound or as directed by manufacturer

B. Pull cleaning plug through conduits to clear of dirt, oil, and moisture.

3.8 CONDUIT SYSTEMS

A. Separate raceways shall be provided for each wiring category as follows:
   1. 120/208 volt or 120/240 volt normal power wiring systems.
   2. 480 volt normal power wiring systems.
   3. I&C: analog
   4. I&C: 120VAC control
   5. I&C: 24VAC control
   6. I&C: pulsed frequency

7. I&C: field instrument signal

B. Fiber-optic cables shall be run in conduit. These raceways shall include sweeping elbows. Fiber-optic cables may be run with other I&C circuit types, but those conduits shall include sweeping elbows.

END OF SECTION

SECTION 16112

CONDUIT FITTINGS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit fittings to form a complete raceway system as specified herein.

1.3 QUALITY ASSURANCE

A. Reference National Electrical Contractors Association (NECA) - Standard of Installation

PART 2 PRODUCTS

2.1 MATERIAL

A. Fittings shall be steel or malleable iron and shall be zinc galvanized, or cadmium plated.

B. Do not use running threads.

C. Do not use set screw or indentor type fittings.

2.2 CONNECTORS AND COUPLINGS

A. Galvanized Rigid Conduit
1. Threaded.
2. Liquid tight.
3. Insulated throat.

B. Polyvinyl Chloride (PVC)
1. Schedule 40 or 80, to match conduit.

C. PVC Coated Galvanized Rigid Conduit
1. Full weight 40 mil PVC jacket.
2. PVC gasketed for mating surfaces.
3. Same as for Rigid Conduit.

D. Liquidtight Flexible Metal Conduit
1. Liquid tight.
2. Suitable for grounding.
3. Suitable for wet locations.

4. Tapered threaded hub.
5. Non-metallic materials.

2.3 EXPANSION FITTINGS

A. Expansion fittings: Copper bonding jumper, Crouse Hinds Type XJ.

B. Expansion/deflection fittings: Copper bonding jumper, Crouse-Hinds Type XD.

2.4 CONDUIT BODIES

A. Galvanized or cadmium plated.

B. Threaded hubs.

C. Removable cover, with gasket.

D. Corrosion-resistant screws.

2.5 SEALS

A. Wall entrance seals. Link Seal type as manufactured by Thunderline Corporation.

B. Explosion-proof seals. Appleton type EYS, SFM, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical fittings in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that fittings serve intended purposes.

B. Rigidly secure connectors at cabinets and boxes with galvanized lock nut and bushing. Use appropriate connectors on NEMA 3R (weatherproof) and NEMA 4 (spraytight) enclosures to maintain their ratings. NOTE: Conduit penetrations to NEMA 3R and NEMA 4 enclosures shall be made on the bottom (or the sides, if the bottom access is insufficient) – do not penetrate the top of the enclosure.

C. Seal conduits that run through different temperature or atmospheric conditions to prevent moisture or gases from entering electrical equipment and devices.

D. Install wall entrance seal where conduits or direct burial conductors pass through foundation walls below grade.

E. Install conduit expansion fittings complete with bonding jumper in following locations:
1. Conduit runs which cross a structural expansion joint.
2. Conduit runs where movement perpendicular to axis of conduit may be encountered.

F. Locate conduit bodies so as to assure accessibility of electrical wiring.

G. Install fittings designed for use with flexible liquid-tight conduit to ensure continuity of ground throughout the fittings and conduit and prevent entrance of moisture.

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRES, CABLES AND CONNECTORS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Application provisions of Division 0 and Division 1 shall govern work under this Section.

1.2 SCOPE

A. Provide wires, cables and connectors as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the following associations.
1. National Electrical Contractor's Association (NECA) - Standard of Installation
2. Insulated Cable Engineers Association (ICEA)

PART 2 PRODUCTS

2.1 WIRE CONDUCTORS

A. Copper Conductor only.

B. Insulated with 600 volt insulation and color code conductors for low voltage (secondary feeders and branch circuits) as required by code.

C. Type THHN solid or stranded: Single conductor No. 10 AWG and smaller for general use wiring. No. 12 AWG minimum size.

D. Type THW or THHN Stranded: Single conductor No. 8 AWG and larger for general use wiring. Conductor triple rated for use as types THHN, THWN and MTW is approved.

E. Conductors installed in wet locations and areas with high humidity shall be type THW or XHHW. Wet locations shall include, but not be limited to, conduits installed in direct contact with the earth and underground electrical ductbanks.

F. Conductors shall not be installed at temperatures below the manufacturer’s minimum installation temperature.

2.2 JOINTS, TAPS AND SPLICES

A. Conductors No. 10 AWG and Smaller: 3M Scotch-lok compression type solderless connectors with plastic cover.

B. Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless compression type connectors, tool and die applied, of a type that will not loosen under vibration or normal strains. Burndy "Hy-Dent" type or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Run wire and cable in conduit, unless otherwise indicated on drawings.

3.2 JOINTS, TAPS AND SPLICES

A. Each tap, joint, or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Electrical tape shall be 3M Scotch brand.

B. Cable splices shall be made only in distribution and junction boxes.

3.3 WIRE AND CABLE IDENTIFICATION

A. Install label tags on wire and cable in junction boxes, pullboxes, wireways, and wiring gutters of panels. Tags identify wire or cable number and/or equipment served as shown on drawings.

B. Different conductor insulation colors and electrical tape colors shall be used to identify the different conductors in a given circuit. Code requirements shall always be followed where applicable. In general, colors shall be as follows;

1. 120/208 volt systems neutral conductor - solid white. Provide additional markings for neutral conductors in the same raceway as required by code.
2. 120/208-volt systems A-phase, B-phase, and C-phase unswitched legs. Solid black, solid red, and solid blue respectively. Different colors shall be used to identify switched legs.
3. 480/277 volt systems neutral conductor - solid gray. Provide additional markings for neutral conductors in the same raceway as required by code.
4. 480/277 volt systems A-phase, B-phase, and C-phase unswitched legs. Solid brown, solid orange, and solid yellow respectively. Different colors shall be used to identify switched legs.
5. Ground Conductors - solid green. Provide additional markings for ground conductors in the same raceway as required by code.

3.4 LIGHTING FIXTURE OUTLETS

A. Use conductor with insulation suitable for current, voltage, and temperature to which conductor will be subjected

B. No. 12 wire size minimum for conductors supplying power to a single fixture. 600V insulation minimum.

C. Fixture wiring shall be continuous wiring system to lampholder or to ballast and from ballast to lampholder.

3.5 TAGS AND LABELS

A. Provide metal or flame-resistant adhesive label tags and identify the cable source, use and destination.

B. Line voltage conductors shall be identified by circuit number using sleeve type adhesive markers.

END OF SECTION

SECTION 16121

FEEDER CIRCUITS

PART 1 GENERAL

1.1 DESCRIPTION

A. Applicable provisions of Division 1 and Division 0 shall govern work in this Section.

B. Requirements of this Section are applicable to feeders as defined in NEC Article 100.

1.2 QUALITY ASSURANCE

A. The installation shall conform to the requirements of the following:
1. National Fire Protection Association (NFPA) - 70 - National Electrical Code (NEC) and Wisconsin amendments thereto.
2. National Electrical Contractors Association (NECA) - Standard of Installation.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which feeders are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.

B. Extend feeders at full capacity from origin to termination.

C. Each conduit raceway shall contain only those conductors constituting a single feeder circuit.

D. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.

E. Where parallel feeder conductors shall be run in separate raceways, each raceway shall have same physical characteristics.

F. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to the minimum temperature gradient and to minimum temperature fluctuation.

G. Confine feeders to insulated portions of building, unless otherwise specified.

H. Trapped feeder runs without facilities for continuous drainage are not acceptable.

I. Do not draw conductors into conduits until building is enclosed and watertight and until work which may cause cable damage has been completed.

J. Feeder conduits shall not be routed in conduit floor slabs or below basement or grade level floor slabs.

K. Each phase conductor of each feeder shall be identified at both ends and at all accessible locations with colored plastic tape. Each phase shall be identified by a different color as indicated in section 16120. Painted identification is not acceptable.

L. Feeder conductors in panelboards, pullboxes, gutters, and other open wiring spaces shall be bundled by feeder using plastic tie wraps at intervals not greater than 3' on center.

END OF SECTION

SECTION 16122

BRANCH CIRCUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide a branch wiring system to serve lighting, receptacle, instrument, motor and equipment loads as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Conductors shall be size 12 AWG minimum (unless otherwise noted) for branch circuit wiring, including motor circuits.

B. Size 120V branch circuits for length of run on following basis:
   1. 0 to 75 ft run from panelboard to first outlet: No. 12 AWG minimum.
   2. 75 to 125 ft run: increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
   3. 126 to 200 ft run: increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
   4. 201 and above: wiring to be sized for 3% maximum voltage drop.

C. Voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC Article 220.

D. Route branch circuits and switch legs as dictated by construction, these specifications, or instruction from Engineer.

E. Size conduit, outlet boxes, and other raceway system components in accordance with NEC requirements as minimum.

F. Do not draw conductor into conduits until building is enclosed and watertight and work which may cause cable damage has been completed.

G. Circuit numbers as shown on drawings are for Contractor to plan his wiring and for estimating purposes and are not necessarily the exact circuit numbers to be used in that panel for that particular load. Exact circuit numbers for each load are to be selected by the Contractor at his option. Balanced load on panelboard bus is to be determining factor in arrangement of circuits. Panelboards average load shall not differ from phase to phase by +/- 7½%.

3.2 MOTOR AND EQUIPMENT WIRING

A. Furnish and install motor circuits in accordance with any schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.

B. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only.

C. Motors shall have proper feeders as per NEC and nameplate ratings. Contractor is responsible for verification of ratings of motors and installing proper branch circuits.

D. Obtain manufacturer's wiring diagrams and shop drawings for equipment requiring electrical connections.

E. Check drawings and specifications of other divisions of work for equipment and work which shall be included in order to provide a complete electrical installation.

F. Motor connections shall be made by compression type connectors using proper tools and fittings to assure good electrical continuity and low resistance joint.

3.3 INSPECTION

A. Examine areas and conditions under which branch circuits are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install in accordance with manufacturer's written instructions and in accordance with recognized industry practices

B. Install branch circuit and control wiring system as indicated in drawings.

C. Use color-coding to identify conductors as indicated in Section 16120.

END OF SECTION

SECTION 16130

ELECTRICAL BOXES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide electrical boxes in accordance with these specifications.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

2.1 INTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED - DAMP OR WET LOCATION (includes areas with floor drains)

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.2 EXTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.3 CEILING BOXES - SURFACE MOUNTED – DAMP AND WET AREAS

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.4 ELECTRICAL BOXES IN CORROSIVE LOCATIONS

A. PVC coated cast steel boxes compatible with conduit system installed. Coating shall cover both interior and exterior surfaces. See floor plans for identification of corrosive areas.

2.5 SPECIAL BOXES

A. Provide special boxes fabricated by the manufacturer of fixtures and other devices where standard outlets are not applicable.

2.6 ACCESS PANELS

A. Furnish type necessary for the particular wall or ceiling construction in which they occur.

B. Panels to be complete with screwdriver cam locking device.

2.7 WEATHERPROOF JUNCTION AND PULL BOXES (EXTERIOR AND DAMP/WET INTERIOR AREAS)

A. Stainless steel or cadmium plated malleable iron cast type with threaded hubs, cast cover, and neoprene gasket.

2.8 EXPLOSION-PROOF JUNCTION BOXES

A. Provide explosion-proof junction boxes for classified areas as indicated on the plans.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as indicated, in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes serve the intended purposes.

B. Seal conduit at entrance to weatherproof boxes for interior and exterior locations exposed to weather or moisture.

C. Install knockout closures to cap unused knockout holes where blanks have been removed

D. Locate boxes so as to assure accessibility of electrical wiring. Relocate boxes rendered inaccessible by the installation of work by other trades.

E. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry. Do not support from conduit.

F. Set boxes, in concealed conduit runs, flush with wall surfaces, with or without covers, as required.

G. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum 12 inches.

H. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with the finished surface.

I. Do not burn conduit holes, use knock-out punches, or hole saws.

J. Use "no-bolt" studs where required.

K. Use handy boxes only where specifically detailed on the drawings.

L. Boxes shall be sized per code to accommodate the number and size of conduit entrances to the box and to accommodate the number of conductors, splices, fittings, etc. within the box. Do not use box extensions to create additional volume to meet NEC requirements for the number of conductors contained in a box.

3.2 EXPOSED OUTLET AND JUNCTION BOXES

A. Install weatherproof outlet and junction boxes outdoors and in any area where drawings show weatherproof (WP) wiring devices.

3.3 INTERIOR OUTLET BOX ACCESSORIES

A. Provide outlet box accessories as required for each installation, such as mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

3.4 LIGHTING FIXTURE OUTLET BOXES

A. Securely mount with approved type bar hangers spanning structural members to support weight of fixture.

B. Do not support from conduit.

C. Equip with 3/8-inch fixture studs and tapped fixture ears, for surface mounted or pendant mounted lighting fixtures. Fixture studs shall be provided for mounting of all lighting fixtures exceeding 25 lbs. in weight. Fixture studs shall be attached through knockouts at the top of the box.

D. Provide additional attachments from structure for outlet boxes supporting lighting fixtures weighing in excess of 25 lb.

E. Provide cast outlet boxes for lighting fixtures in wet or damp areas.

3.5 OUTLET BOX LOCATIONS

A. Locate flush mounted wall boxes in corner of nearest brick or block to keep cutting to a minimum.

B. Location of outlets and equipment as shown on drawings is approximate, and exact location is to be verified and shall be determined by:

C. Construction or code requirements.

D. Conflict with equipment of other trades.

E. Equipment manufacturer's drawings.

F. Where receptacles and communications outlets are shown grouped next to each other on the drawings, the boxes for these outlets shall be mounted next to each other and shall not be located according to stud spacing. The Contractor shall utilize between stud box supports to assist in mounting boxes proximal to one another on a consistent spacing between wall studs.

G. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet, provided the change in location is requested prior to rough in.

H. Mounting heights for devices and equipment to be measured from finished floor to centerline of device.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in the Section.

1.2 SCOPE

A. Provide wiring devices generally consisting of switches and receptacles as indicated on the drawings and as specified herein.

1.3 SHOP DRAWING SUBMITTALS

A. Listing of brand names and types of materials proposed for use.

B. Nameplate nomenclature.

C. Electrical ratings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Use of manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired only.

B. Arrow-Hart, Inc.

C. Hubbell Wiring Device Div.

D. Pass and Seymour, Inc.

E. Crouse-Hinds

F. Leviton

G. General Electric

2.2 GENERAL

A. Provide factory-fabricated, NEMA specification grade wiring devices in type, color, and electrical rating for service indicated.

B. Provide wiring devices of one manufacturer.

C. See Symbols List on drawings for identification of device type.

D. Wiring devices for use with stranded conductor shall have a clamping type terminal that can be physically tightened. The clamping device shall not be a spring type of clamp.

2.3 SWITCHES

A. Single Pole Switch:
1. Hubbell Model 1221-I.
2. Arrow-Hart. Model 1991-I.
3. Or equal.

B. Double Pole Switch:
1. Hubbell. Model 1224-I.
2. Arrow-Hart Model 1992-I.
3. Or equal.

C. Three-way Switch:
1. Hubbell. Model 1223-I.
2. Arrow-Hart. Model 1993-I.

D. Indicator Switch:
1. Hubbell. Model 1221-Il.
2. Arrow-Hart. Model 1921-IL.
3. Or equal.

E. Locator Switch:
1. Hubbell. Model 1221-PL.
2. Arrow-Hart. Model 1991-PL.
3. Or equal.

F. Weather Proof Switch:
1. Hubbell. Model 1221/Crouse-Hinds DC 1SBG Cover
2. Or equal.

G. Explosion Proof Switches:
1. Appleton. Model EFS Series.
2. Crouse-Hinds. Model EFS Series.

2.4 RECEPTACLES

A. Duplex Convenience Receptacle:
1. Hubbell. Model 5262-I.
2. Arrow-Hart. Model 5262.
3. Or equal.

B. GFCI Receptacle:
1. Hubbell Model GF – 5362 – Indoor with WPFS26 Outdoor.

2. Or equal.

C. Explosion-proof Receptacle:
1. Appleton Model EFS B175-2023M.
2. Crouse-Hinds Model ENR 21201.
3. Or equal.

2.5 WIRING DEVICE PLATES AND COVERS

A. Provide wall plates for wiring devices, with ganging and cutouts as indicated and with metal screws for securing plates to devices, screw heads colored to match finish of plate.

B. Plates for flush mounted devices in dry areas: Coverplates shall be of plastic, non-combustible, mar-proof thermosetting material, minimum 0.100" thick. Color of plates shall be of ivory except that color shall be red for devices associated with emergency circuits.

C. Device plates for surface mounted Type FS or FD boxes: Type FSK galvanized steel cover.

D. Device plates for surface mounted 4-inch square boxes: ½ in. raised galvanized steel covers.

E. Plates and covers for exterior outlet boxes and exterior switch boxes in damp or wet locations: Stainless steel with gasketed, lift, spring close, locking coverplate. Pass and Seymour model number WP26-L.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which wiring devices are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Do not install devices until wiring is complete.

C. Do not install devices until after wall finishes (wall covering, painting, wallpaper, etc) have been completely applied. Any outlets installed prior to walls being finished and used for construction power shall be replaced at the time of substantial completion.

D. Before installing receptacles and switches, clean electrical boxes of dirt and debris.

E. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped or otherwise. Make circuit connections via wire connectors and pigtails.

F. Install gasket plates for devices or system components having light emitting features, such as switches with pilot lights. Where installed on rough textured surfaces, seal plates with black self-adhesive poly-foam.

G. Ground receptacles with an insulated green ground wire from device ground screw to a bolted outlet box connection. Route a continuous green equipment grounding conductor with branch circuit conductors serving isolated ground receptacles. Terminate the equipment ground on the ground bus in panelboards.

H. Stranded conductor terminating on wiring devices shall be terminated in a clamping terminal and not on the screw terminal.

I. Provide a layer of electrical tape around the perimeter sides of each wiring device so that the terminations are insulated.

J. Where GFI protected receptacles are indicated on the plans, each receptacle indicated shall be a GFI receptacle. Standard receptacles protected with an upstream GFI receptacle shall not be approved.

3.3 FIELD QUALITY CONTROL

A. Provide operational testing for all devices.

B. Test receptacles with Hubbell 5200, Woodhead 1750, or equal, for correct polarity. proper ground connection, and wiring faults.

END OF SECTION

SECTION 16170

MOTOR AND CIRCUIT DISCONNECTS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide disconnect switches for the safe disconnection of motorized equipment and other equipment as required by the national and state electrical codes, O.S.H.A., and as specified herein.

1.3 SHOP DRAWING SUBMITTALS

A. Enclosure dimensions nameplate nomenclature, electrical ratings, and fuse and breaker type listing.

B. Field quality control test results.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store exposed to weather.

B. Protect against damage from work of other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric

B. Siemens

C. Square D

D. Cutler-Hammer\Westinghouse\Eaton

2.2 DISCONNECT RATINGS

A. UL listed short circuit rating. 200,000 RMS amps with Class R fuses.

2.3 SAFETY SWITCH CONSTRUCTION

A. Twenty amp, one pole, non-fusible.
   1. Toggle type operator.
   2. Toggle guard capable of locking switch in the on or off position.
   3. Rated 1HP at 120 volts AC.

B. Switches other than twenty amp, one pole.
   1. NEMA heavy duty Type HD.
   2. Dual cover interlock.
   3. Visible blades.
   4. Provisions for control circuit interlock (aux. contacts). Once Form C set of aux. contacts is required for each disconnect associated with a VFD-driven load.
   5. Pin type hinges.
   6. Tin plated copper current carrying parts.
   7. Quick make and break operator mechanism.
   8. Handle attached to box, not cover.
   9. Handle position indication, ON in up position and OFF in down position.
   10. Padlock provisions for up to three padlocks in OFF position.
   11. UL listed lugs for type and size of wire specified.
   12. Spring reinforced fuse clips for Type R fuses where fusible disconnect is indicated or required.
   13. Provisions for insulated or grounded neutral.

2.4 ENCLOSED CIRCUIT BREAKER CONSTRUCTION

A. Dual cover interlock.

B. External trip indication.

C. Provisions for control circuit interlock.

D. Padlock provisions for up to three padlocks in OFF position.

E. Handle attached to box, not cover.

F. Handle position indicates ON, OFF, or TRIPPED.

G. Provisions for insulated or grounded neutral.

2.5 ENCLOSURES

A. Indoor dry areas. NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish.

B. Indoor damp or below grade. NEMA 3R.

C. Indoor wet. NEMA 4.

D. Outdoor. NEMA 4.

E. Corrosive Area. NEMA 4X Type 304 stainless steel with brushed finish.

F. Hazardous Area. NEMA 7/9 cast, copper free, aluminum alloy.

2.6 NAMEPLATES

A. Engraved laminated plastic type.

B. Letters 1/2 in. high.

C. Black letters on white background.

D. Identify per equipment controlled.

PART 3 EXECUTION

3.1 GENERAL

A. Provide a disconnect switch for each motorized load and for each electrical heating load, whether indicated on the drawings or not. Each local disconnect switch shall be located within line-of-sight of the associated load, and shall be suitably rated. The Contractor shall provide a pedestal in each case where there is no suitable vertical surface for mounting a disconnect switch. Some equipment is furnished with an integral or loose disconnect switch, so the Contractor shall review all specifications to determine what equipment is furnished with a disconnect switch. The Contractor shall include in their bid all disconnect switches required whether indicated on the drawings or not.

3.2 INSPECTION

A. Examine area to receive disconnect to assure adequate clearance for installation.

B. Start work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Locate disconnect switches as shown on drawings or as required by NEC.

C. Install on equipment support where feasible, or anchor firmly to wall or structural surface.

D. Provide control circuit interlock as required by NEC.

E. For each disconnect switch associated with an ASC, provide two #12 wires in a ¾” conduit back to the ASC.

3.4 ADJUSTMENT

A. Adjust covers and operating mechanism for free mechanical movement.

B. Verify overcurrent protection to provide proper operation and compliance with NEC.

C. Tighten wire and cable connections.

D. Clean interior of enclosure.

E. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section

1.2 SCOPE

A. Provide equipment for the support of electrical equipment as detailed or indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference standards of the following agencies;
1. National Electrical Contractors Association (NECA), Standard of Installation.
2. National Electrical Manufacturers Association (NEMA).
3. American National Standards Institute (ANSI).

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kindorf, Midland-Ross Corp.

B. Elcen Co.

C. Steel City, Midland-Ross Corp.

D. Unistrut

E. B-Line

2.2 GENERAL

A. Metal supporting devices shall be zinc galvanized or cadmium plated steel or malleable iron.

2.3 LIGHTING FIXTURE SUPPORT

A. Items such as stems, hickeys, bar hangers, and clips are required to securely attach fixtures to ceilings or walls.

B. Provide studs and unistrut support for fixture outlet and ceiling support.

C. Drilled expansion insert type anchors are suitable for load and application requirements such as sleeve anchors, lag shields, and plastic anchors.

D. Provide auxiliary supports so that fixtures can be drawn up tightly, cannot be tilted or rotated, and will not be affected by vibrations.

2.4 SUPPORT STRUCTURES

A. Rack supports of galvanized steel channel sections with adequate feet to allow secure mounting.

B. Weld sections, do not use bolts.

2.5 MOUNTING PANELS

A. Size mounting panels to mount necessary equipment, of ¾ in. exterior grade plywood or as specified on drawings.

B. Provide mounting panels for all surface mounted electrical cabinets and enclosures for electrical equipment.

C. Provide uniform mounting panels as far as practical. Preferred sizes being 12 in. X 18 in., 18 in. X 24 in., 18 in. X 30 in., and 24 in. X 30 in.

2.6 CONDUIT SUPPORTS

A. Two hole galvanized steel straps.

B. Continuous slot or T-slot galvanized steel concrete insert channel.

2.7 TRANSFORMER MOUNTING BRACKETS

A. Provide mounting brackets fabricated of welded galvanized steel channel section.

B. Design bracket to support the size transformer as indicated on drawings.

PART 3 EXECUTION

3.1 PREPARATION

A. Install hangers, supports, and anchors only after structural work, where work is to be installed, has been completed. Correct inadequacies such as proper placement of inserts, anchors, and other building structural attachments.

B. Examine areas and conditions under which equipment and associated components are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on to structural steel or raceway and equipment support.

B. Install additional building attachments where support is required for additional concentrated loads.

C. Install concrete inserts before concrete is placed.

3.3 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment.

B. Installation methods shall be in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than four bolt diameters. Minimum distance between the center of any expansion anchor and an edge of exterior corner of concrete shall be not less than 4½ times the diameter of the hole in which it is installed.

3.4 SUPPORT OF CONDUIT

A. Fasten conduit to structural parts of building in a manner acceptable to Engineer.

B. Do not use perforated hanger iron.

C. Install concrete insert channel as required, with spacings as recommended by manufacturer. Install with anchor and caps, insert joiner clips and closer seals as required.

D. Support conduit as follows;
   1. Single Conduit Runs
      a. Vertical Surfaces: Galvanized, heavy duty, sheet steel straps; back straps to be provided for all exposed conduit and conduit on exterior walls.
      b. Horizontal Surfaces: Galvanized, heavy duty, 2-hole steel pipe straps.
   2. Multiple Conduit Runs
      a. Vertical Surfaces: Horizontal or vertical rack channel with conduit straps as required.
      b. Horizontal Surfaces: Single or double rack channel trapeze, complete with conduit straps as required; all supported with threaded hanger rods.
   3. Passing Between Floors and Through Roof 1¼ in. and larger conduit runs passing through floors shall be supported at each floor with riser pipe clamps.
   4. Conduit extending through roof shall pass through a ceiling box at roof lines.
   5. Provide 14 ga minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.
   6. Conduit and pitch pocket shall be installed in advance of roofing work.

3.5 TRANSFORMER SUPPORTS

A. Install auxiliary transformer wall mounting brackets where all mounted transformers are indicated on drawings.

END OF SECTION

SECTION 16402

UNDERGROUND ELECTRIC SERVICE

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide facilities for an underground electrical service as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference the local electrical utility's Service Rules and Regulations.

1.4 SUBMITTALS

A. Submit shop drawings of service entrance equipment for approval by the Electrical Utility before submitting approved drawings to Engineer.

PART 2 PRODUCTS

2.1 ELECTRIC SERVICE

A. Electric service characteristics for this project shall be as indicated on drawings.

PART 3 EXECUTION

3.1 PREPARATION

A. Confirmation of electric service. Consult with Electric Utility to verify service information specified herein and shown on drawings before submitting bid.

B. Metering.
   1. Consult with Electric Utility regarding service entrance requirements and metering equipment.
   2. Install metering equipment and empty conduit for metering conductors to meet standards and requirements of Electric Utility.

C. Electric Utility Charges. Include in Base Bid the Electric Utility charges for incoming underground electrical service.

3.2 SERVICE INSTALLATION

A. Provide a ductbank extension from the building for incoming service lateral conductors as shown on drawings.

B. The service installation shall comply with the latest applicable standards of the utility. Refer to the current electrical service installation manuals.

C. The Contractor shall meet with the electric utility prior to rough-in to review and coordinate the installation of the electrical service and verify existing conditions and any special requirements.

D. If requested by the Utility or Engineer, the Contractor shall meet with the Utility at the project site at the time of new service installation.

END OF SECTION

SECTION 16421

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall apply to all work of this Section.

1.2 DESCRIPTION

A. Furnish and install Category C surge protective devices (SPDs) as shown on the drawings and herein specified. Unit shall have a 160KA surge handling capacity, minimum.

1.3 QUALITY ASSURANCE

A. Each SPD shall be listed under UL 1449 Third Edition, labeled and tested to ANSI/IEEE Standards C62.41-1996.

B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.4 SUBMITTALS

A. Product data required.

B. Submittal shall include confirmation of ALL ratings specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. MCG

B. Engineer – approved equal.

2.2 ENVIRONMENTAL REQUIREMENTS

A. Storage temperature range shall be -40°C to 85°C.

B. Operating temperature range shall be -40°C to 70°C.

2.3 DOCUMENTATION

A. Manufacturer shall furnish an installation manual with installation, start up and operating instructions for the specified system.

B. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details and wiring diagram.

C. Documentation of specified system's UL 1449 listing and clamping voltage ratings shall be included as required product data submittal information.

2.4 WARRANTY

A. Manufacturer shall provide a full ten year warranty against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements and any applicable national or local electrical codes. Replaceable modules shall have a lifetime warranty from the Manufacturer.

2.5 EQUIPMENT

A. Unit shall include special low impedance interface cable.

B. LED indicators shall be provided on the front cover to redundantly indicate unit module status. The system shall reliably indicate that one or more surge current diversion modules has failed and that service is needed to restore full operation. Additionally, a Form C (one N.O. and one N.C.) summary alarm contact rated for at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current diversion modules has failed.

C. Specified system shall be equipped with an audible alarm which shall be activated when any one or more of the surge current diversion modules has failed.

D. A TVSS counter shall be included to totalize transient voltage surges.

E. Unit shall include noise filtering.

F. Unit shall protect L-G, L-N, L-L, and N-G.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all surge suppressors where shown on drawings in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide all material, labor and incidentals necessary for the completion of this section of the work.

1.3 QUALITY ASSURANCE

A. Follow the requirements of the following regulatory agencies;
1. National Fire Protection Association (NFPA), NFPA-70 - National Electrical Code (NEC) and Wisconsin amendments thereto.
2. Local Codes and Ordinances

1.4 REFERENCE STANDARDS

A. Conform to the standards of the National Electrical Contractors Association (NECA), Standard of Installation.

1.5 SUBMITTALS

A. Ground rod locations.

B. Ground resistance at each ground rod.

C. Soil conditions.

PART 2 PRODUCTS

2.1 GROUND CLAMPS

A. Ground clamp fittings shall be interlocking clamp type fabricated from high strength corrosion-resistant metal with high strength silicon bronze U-bolt, nuts, and lock washers.

2.2 GROUND RODS

A. Thick copper covering inseparably welded to a strong steel core.

B. ¾ in. diameter minimum

C. Ten feet long minimum

D. Furnish and install up to three rods, positioned in a triangular pattern (spaced 15 feet apart) to achieve 5 ohms or less.

2.3 GROUND WIRES

A. Copper only

B. Size as shown on drawings, or as required by NEC

C. No. 6 AWG minimum

PART 3 EXECUTION

3.1 GENERAL

A. Ground electrical systems and equipment as required by code, utility, local ordinances, and to requirements herein.

B. Install separate code rated grounding conductors to special equipment and activity areas as required by code.

C. Bond all metallic piping systems and service equipment as required by NEC.

D. Cable connections and joints shall be thermo-welded.

3.2 SYSTEM GROUND

A. Attach grounding electrode conductor to point ahead of water meter or service shut-off valve. Grounding electrode conductor shall be permitted to be attached to other grounding electrodes where available in the building as defined in NEC Article 250-81 in lieu of attaching to water service.

B. Water piping system ground shall be augmented by 2 NEC approved grounding electrodes so as to achieve an effective ground resistance as required by code and as shown on the plans. Building steel shall be used where available.

C. Drive ground rods to a depth 4 inches below finished grade.

D. Grounding electrode conductor.
1. Continuous without splice from nearest building grounding electrode. Ground to service equipment.
2. Install bonding jumper around water meter.
3. Install in rigid metal conduit securely fastened to pipe.
4. Attach non-ferrous metal tag to warn against removal.
5. Make connections to ground electrodes with approved molded exothermic weld process.

3.3 EQUIPMENT GROUND

A. Bond metallic conduits, supports, cabinets, and other equipment so ground will be electrically continuous from service to outlet boxes.

B. Install grounding conductor in nonmetallic and flexible conduit to complete equipment ground continuity. Ground wire shall be bonded at equipment and at first junction box of conduit system on line side of flexible conduit to the system.

C. Install grounding conductors to permit shortest and most direct path from equipment to ground. When grounding conductor runs through metallic conduit, bond to conduit at entrance and exit with a bolted clamp.

D. Ground neutral at service-entrance only.

E. Install a separate equipment grounding conductor in each conduit containing feeder conductors.

F. Install a green equipment grounding conductor in all conduits serving receptacles and special purpose outlets.

G. Green ground bar in panels: shall be similar to neutral bar, except tinted green and bonded to panel tub.

H. Connections shall be accessible for inspection and checking. No insulation shall be installed over ground connections.

I. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

J. Attach grounds permanently before permanent building service is energized.

K. Attach ground wire neatly and firmly to walls.

3.4 FIELD QUALITY CONTROL

A. Contractor shall make ground resistance measurements. Measure in normally dry conditions, not less than 48 hours after rainfall.

B. Report ground resistance measurement to Engineer within 48 hours of measurement.

END OF SECTION

SECTION 16461

LOW VOLTAGE DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work of this Section

1.2 SCOPE

A. Provide auxiliary transformers of the KVA rating and voltage characteristics as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Equipment shall conform to the requirements of the following agencies:
1. National Fire Protection Association (NFPA). National Electrical Code (NEC) and Chapter 70 and Wisconsin amendments thereto.
2. Underwriters' Laboratories, Inc. (UL)
3. Local Codes and Ordinances.
4. National Electrical Manufacturers Association (NEMA)
5. American National Standards Institute (ANSI)
6. National Electrical Contractors Association (NECA)

B. Transformers shall be subject to the following production tests:
1. Applied potential.
2. Induced potential.
3. No load losses.
4. Voltage ratio.
5. Polarity.
6. Continuity.

1.4. SUBMITTALS

C. Shop drawings shall be in accordance with Section 16010. Shop drawings shall include:
1. Manufacturer's nameplate data and electrical ratings.
2. Dimensioned drawings of transformers and accessories.
3. Submit operating and maintenance data.
4. Submit field quality control test and adjustment data

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric

B. Square D

C. Siemens

D. Cutler-Hammer/Westinghouse/Eaton

2.2 MATERIALS AND EQUIPMENT

A. Transformers shall be dry type, air cooled.

B. Insulation shall be Class H or better, having a minimum 115°C. rise, average maximum over 40°C. temperature ambient.

C. Cores shall be high grade, non-aging, sheet silicon steel laminations having core plating insulation on both sides of each lamination.

D. Coils shall be continuous wound, impregnated with non-hygroscopic varnish, and the coil/core shall be bolted to bottom of enclosure. Coil conductors shall be continuous with termination pad brazed or welded.

E. No metal-to-metal contact shall occur between coil/core and enclosure. Coil/core and enclosure shall be isolated by rubber, vibration absorbing mounts.

F. Transformer shall contain four taps. Two 2½% taps above and two 2½% taps below.

G. Overload Capacity shall be not less than 15% for continuous operation.

H. Sizes as indicated on drawings and schedules.

I. Transformers shall be quiet type for installation in areas of low ambient noise levels. Maximum sound levels shall not exceed NEMA standards.

J. Cabinets shall be sheet steel, phosphatized having one prime coat and two finish coats of baked enamel.

K. Wall mounting brackets through 75 KVA.

L. Nameplate shall be a metal nameplate listing manufacturer's name, serial number, type, class, KVA voltage, frequency, and showing internal wiring diagram.

M. The following requirements shall be in accordance with Underwriters' Laboratories specification UL506:
1. Ventilation openings.
2. Corrosion resistance.
3. Cable bending space.
4. Grounding provisions.
5. Surface temperature.
6. Winding compartment temperature rise.
7. Terminations.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which transformers are to be installed and notify Engineer, in writing, of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TRANSFORMERS

A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.

B. Install wall mounted transformers on prefabricated brackets designed for purpose.

C. Install floor mounted transformers on 4 in. concrete housekeeping pad.

D. Tighten bus connections and mechanical fasteners.

E. Install fuses or breakers as shown on drawings.

F. Adjust voltage taps for required system voltage and check grounding requirements.

G. Touch up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Test and permanently record as follows:
   1. Prior to energization of transformers, check phase-to-phase and phase-to-ground insulation resistance levels.
   2. Check transformers for continuity of circuits and for short circuits.
   3. Subsequent to wire and cable hook-ups, energize transformers and demonstrate function.

3.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle carefully to prevent internal component damage, breakage, and denting and scoring the enclosure finish. Do not install damaged transformers.

B. Store transformers in a clean dry space. Protect from dirt, fumes, water, construction debris, and physical damage

END OF SECTION

SECTION 16470

ELECTRICAL PANELBOARDS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide panelboards as indicated in the panel schedule, as noted on the drawings and as specified herein.

1.3 SUBMITTALS

A. Shop Drawings
1. Cabinet dimensions, nameplate nomenclature, electrical ratings, and breaker type listing.
2. Product data sheets with installation instructions.
3. Field quality control test results.
4. Operating and maintenance data.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Do not store panelboards exposed to weather.

B. Protect panelboards against damage from work of other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Use of a manufacturer's name and model or catalog number is for the purpose of establishing standard of quality and general configuration desired.

B. Square D

C. Siemens

D. General Electric

E. Cutler-Hammer/Westinghouse/Eaton

2.2 PANELBOARD RATINGS

A. UL listed short circuit rating (integral equipment rating):
   1. 208Y/120V and 120/240V Lighting Panels: 10,000 RMS symmetrical amperes minimum equivalent to Square D type NQOD.
   2. 480Y/277V Lighting Panels: 14,000 RMS symmetrical amperes minimum equivalent to Square D type NEHB.
   3. Power Panels: 22,000 RMS symmetrical amperes minimum or as specified on the drawings. Equivalent to Square D I-Line.

2.3 PANELBOARD CONSTRUCTION

A. Main breaker or main lugs only, per panelboard schedule.

2.4 BUSSING

A. Plated copper phase bussing.

B. Plated copper neutral bus with terminals.

C. Copper equipment grounding bus with terminals.

D. Distributed phase sequence type.

E. Ratings per panelboard schedule, 100 amp minimum.

2.5 PANEL CABINETS

A. Code gauge galvanized steel.

B. Minimum 20" wide.

C. Minimum 5¾" deep.

D. Height as required to accommodate breakers and spaces indicated on plans and code required gutter space

E. Gutters adequate for wire size used, 4 inches minimum.

2.6 PANEL FRONTS

A. Dead front safety type.

B. Concealed adjustable trim clamps.

C. Code gauge steel with rust inhibiting primer and baked enamel finish.

D. Panel front cover shall have piano hinge to allow access to wiring gutters with out removal of panel trim. Hinged trim held in place with screw fasteners. Door shall be

built into trim which allows access to breakers as well as to hinged trim screw fasteners. Breaker access door shall have the following features.

1. Concealed piano hinge.
2. Flush stainless steel cylinder tumbler type locks with spring loaded door pulls.
3. Locks for all job panels keyed alike.
4. Steel frame circuit directory holder with directory cards on inside face.
5. Suitable for complete descriptions.
6. Clear plastic cover.

2.7 BRANCH BREAKER DETAILS

A. Conform to Section 16475.

B. UL Class A ground fault circuit protection (GFI) as indicated on drawings.

C. UL listed terminals for type and temperature rating of wire utilized. Anti-turn solderless type.

D. Circuit breaker construction for NQOD and NEHB panels shall bolt on to panel bussing.

E. Circuit breaker construction for I-Line panels shall plug on to panel bussing but breaker cases shall bolt to panel cabinet.

2.8 NAMEPLATES

A. Engraved laminated plastic type.

B. Letters 1/2 inch high.

C. Black letters on white background.

D. Verify final panelboard designation with the owner's representative.

2.9 ARC FLASH WARNING LABELS

A. All panelboards shall include a warning label indicating the risk of arc flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

B. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Surface mount or as specified on drawings and schedules.

C. Support panel cabinets independently to structure with no weight bearing on conduits.

D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.

E. Install panelboards so top breaker is not higher than 6 ft-0 in. above floor.

F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.

G. Install in each panelboard a typewritten directory accurately indicating rooms and/or equipment being served.

H. Attach nameplates. Nameplates for panels in equipment rooms and other non-public areas shall be attached to the outside face of the cover.

3.3 FIELD QUALITY CONTROL

A. Balance load among feeder conductors.

B. Unbalance shall not exceed ± 7½% of computed average load per phase.

C. Energize each circuit and check for complete and correct function.

3.4 ADJUSTMENT AND CLEANING

A. Adjust doors and operating mechanisms for free mechanical movement.

B. Tighten lugs and bus connections.

C. Clean interior of panelboard.

D. Sand, prime and paint scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16475

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide overcurrent devices of the sizes and interrupting ratings as indicated on the drawings and as specified herein.

1.3 SUBMITTALS

A. Shop Drawings
1. Device dimensions, nameplate nomenclature and electrical ratings.
2. Product data sheets with installation instructions.
3. Time current characteristic curves for each size and type of device.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fuses.
1. Bussmann
2. Chase Shawmut

B. Molded case circuit breakers.
1. Square D
2. Westinghouse/Cutler-Hammer/Eaton Co.
3. Siemens
4. General Electric

2.2 250 VOLT FUSE TYPES

A. Class RK-1, one end rejection or to fit mountings specified. 0-600 ampere, 200,000 ampere interrupting rating. Equivalent to Bussmann Low-Peak. LPN-R, dual element, time delay with short circuit protection for motor, transformer, welder, feeder and main service protection.

2.3 600 VOLT FUSE TYPES

A. Class RK-1, one-end rejection or to fit mountings specified, 0-600 ampere, 200,000 ampere interrupting rating. Equivalent to Bussmann Low-Peak. LPS-R, dual element,

time delay with short circuit protection for motor, transformer, welder, feeder and main service protection.

B. Class L, bolt-in, 601-6,000 amperes, 200,000 ampere interrupting rating. Equivalent to Bussmann HI-CAP. KRP-C, time delay for overload and short circuit protection for motor, transformer, feeder and main service protection.

C. Class CC, fast acting, single element, 0-30 amperes, 200,000 ampere interrupting rating. Equivalent to Bussmann Limitron KTK-R standard non-rejection, UL listed for motor control circuits, lighting ballasts, control transformers and street lighting fixtures.

2.4 SPARE FUSES

A. Provide 100% spare (minimum of three) of each type and rating of installed fuses.

2.5 LIGHTING PANEL CIRCUIT BREAKERS

A. Thermal and magnetic protection.

B. Single-handle common trip, two and three poles (handle ties not acceptable).

C. Bolt-on type.

D. Quick make and break toggle action.

E. Handle trip indication.

F. Handle position indication, ON in up position, OFF in down position, and TRIPPED centered.

G. UL listed for type and temperature rating of wire specified.

H. UL listed short circuit rating (integrated equipment rating):
1. Up to 240V: 10,000 RMS symmetrical amperes minimum.
2. Up to 480V: 14,000 RMS symmetrical amperes minimum.

I. UL SWDL switching duty on 120V circuits where loads are panel switched.

2.6 POWER PANEL CIRCUIT BREAKERS

A. Thermal and magnetic protection.

B. Magnetic protection only, in combination with motor starters and motor circuit protectors (MCP).

C. Single magnetic trip adjustment.

D. Single-handle common trip, two and three poles (handle ties not acceptable)

E. Push-to-trip test button.

F. Breakers shall plug on to panel bussing but breaker cases shall be bolted to panel housing.

G. Quick make and break toggle action.

H. Handle trip indication.

I. Handle position indication, ON in up position, OFF in down position, and TRIPPED center.

J. UL listed for type and temperature rating of wire specified.

2.7 CURRENT LIMITING CIRCUIT BREAKERS

A. One current limiter per pole.

B. Blown current limiter to trip all poles.

C. UL Listed Short Circuit Rating: 100,000 RMS symmetrical amperes.

D. Other features as specified above.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine fusible equipment for size and type of fuse to ensure selective coordination.

B. Install fuses only after selective coordination has been made.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. All overcurrent protection devices by same manufacturer.

C. Circuit breakers shall be factory installed in enclosures.

D. Fuses shall not be installed until equipment is ready to be energized.

3.3 ADJUSTMENT

A. Adjustable settings on circuit breakers shall be set to provide selective coordination, proper operation and compliance with NEC.

3.4 FIELD QUALITY CONTROL

A. Test and/or permanently record the following:

B. Fuses
   1. Equipment nameplate requirement
   2. Actual fuse rating

C. Circuit Breakers
   1. Nameplate data
   2. Actual trip setting

END OF SECTION

SECTION 16481

MOTOR STARTERS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide and install motor starters of the types as indicated on the drawings and as specified herein

1.3 SUBMITTALS

A. Shop Drawings

B. Showing enclosure dimensions, nameplate nomenclature, electrical ratings and thermal unit schedule.

C. Product data sheets with printed installation instructions.

D. Wiring diagrams and schematics.

E. Identify with tag number for proposed use.

F. Operating and Maintenance Data

G. Manufacturer's printed instructions for replacing parts, performing cleaning and operating and maintaining motor starters.

H. Repair parts list.

I. Field quality control test results.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store motor starters exposed to weather.

B. Protect motor starters against damage from work of other trades.

PART 2 PRODUCTS

2.1 GENERAL

A. Use of a manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired only.

B. Starters shall be by one manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

A. Allen Bradley

B. Cutler-Hammer/Westinghouse/Eaton

C. Square D

D. General Electric

E. Siemens

2.3 MANUAL MOTOR STARTER CONSTRUCTION

A. Quick-make and break toggle action.

B. Double-break silver alloy contacts.

C. One-piece bi-metallic or melting alloy type thermal overload units.

D. Starter inoperative, unless thermal unit is in position.

E. Provision for padlocking in the "off" position.

F. Green pilot light to indicate when motor is running.

G. NEMA standards for size and horsepower rating.

H. Provisions for resetting starter after overloads trip the starter.

2.4 MAGNETIC COMBINATION TYPE MOTOR STARTER CONSTRUCTION

A. Built-in circuit breaker type disconnect switch with external disconnect handle with capability to padlock in the open position. Size circuit breaker as indicated on the drawings.

B. Mounted in vertical position.

C. Double-break silver alloy contacts.

D. Molded coil through Size 6.

E. Wound, taped, varnished and baked coils Sizes 7 and 8.

F. Contacts and coil replaceable without removing starter from enclosure or power wiring from starter

G. Straight-through wiring.

H. Overload Relay - General Application

I. One-piece thermal unit construction.

J. One bi-metallic or melting alloy type overload relay per phase, manually reset.
1. Interchangeable thermal units.
2. Thermal units must be in place to operate starter.
3. Replaceable overload relay circuit contacts.
4. Trip at 6 times FLA in 20 seconds.

K. Overload Relay - Submersible Pumps and Hermetically Sealed Motors
1. One-piece thermal unit construction.

L. One bi-metallic or melting alloy type overload relay per phase, manually reset.
1. Interchangeable thermal units.
2. Thermal units must be in place to operate starter.
3. Replaceable overload relay circuit contacts.
4. Trip at 6 times LRA in 3-5 seconds.

M. NEMA standards for size and horsepower ratings.

NEMA Size	Max HP @ 208V	Max HP @ 480V
1	7½	10
2	10	25
3	25	50
4	40	100
5	75	200
6	150	400

N. NEMA Size 1 minimum, or as noted on drawings.

O. Control Circuits
1. Provide a control transformer mounted in starter enclosure. Verify the control voltage required with the temperature control contractor.
2. Two fuses on control transformer primary side and single fuse on secondary line.
3. One secondary line grounded.
4. Transformer sized for device, accessories connected there to and 25% extra capacity minimum.

P. Accessories
1. Reset button mounted in enclosure cover.

2. Heavy duty, oil-tight, green "running", and red "off" lights mounted in enclosure cover.
3. Heavy duty, oil-tight, Hand-Off-Auto selector switch mounted in enclosure cover.
4. Furnish two normally open and one normally closed auxiliary contacts in each starter.
5. Make provisions for mounting in a motor control center where indicated on the drawings.

2.5 ENCLOSURES

A. Indoor dry
1. MANUAL STARTERS: General purpose flush mounted in finished areas or NEMA 1 surface mounted in unfinished areas.
2. MAGNETIC STARTERS: NEMA 1 surface mounted.
3. SOLID STATE STARTERS: NEMA 1 surface mounted.

B. Indoor damp or below grade
1. NEMA 3R.

C. Outdoor or indoor wet
1. NEMA 4.

D. Corrosive Area
1. NEMA 4X stainless steel.

2.6 NAMEPLATES

A. Engraved laminated plastic.

B. Letters 1/2 in. high.

C. Black letters on white background.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive motor starter to assure adequate clearance for motor starter installation.

B. Start work only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized practices.

B. Install in MCC or mounted firmly to wall of structural surface. Refer to plumbing plans and heating, ventilating and air conditioning plans for starter locations.

3.3 FIELD QUALITY CONTROL

A. Megger check of phase-to-phase and phase-to-ground insulation levels. Do not megger check solid state equipment.

B. Test for continuity between line and load terminals and between control terminals.

C. Short circuit.

D. Operational check.

E. Test each motor and permanently record following information:
   1. Motor identification as to the load served.
   2. Nameplate data.
   3. Overload relay equipment.
   4. Protective relay (if any) setting.
   5. Voltage and current phase readings.
   6. Direction of rotation.
   7. Furnish spare overloads in each size utilized and turn over to owner.
   8. Provide a spare control transformer for each starter size utilized and turn over to owner.

3.4 ADJUSTMENT AND CLEANING

A. Adjust covers and operating mechanisms for free mechanical movement.

B. Tighten wire and cable connections.

C. Verify over current protection thermal unit size with motor nameplate to provide proper operation and compliance with NEC.

D. Clean interior of enclosure.

E. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16483

ADJUSTABLE SPEED CONTROLLERS (ASC)

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Detailed design, fabrication, installation, and testing of adjustable speed controller systems as scheduled and as shown on the drawings.

1.2 SUBMITTALS

A. SHOP DRAWINGS: Submit under the provisions of Section 01300. A reviewed set will be returned to the supplier for fabrication. The shop drawings shall include the following:
   1. Prior to shop drawing submittal for adjustable speed controller systems, obtain detailed motor load information from equipment manufacturer.
   2. Submit system hydraulic analysis including graphs and tabular information for the following:
      a. Input horsepower versus flow (minimum design flow to maximum design flow) taking into account pump, AFD and motor efficiencies.
      b. System curve versus pump curve at 100 percent speed and in 10 percent increments until minimum pump speed at which pump does not generate enough head to overcome static head is reached. Plots must also show curves of constant hydraulic horsepower to verify non-overloading.
      c. Tabulated data shall be calculated at 2 +percent speed increments.
   3. Submit harmonic voltage distortion analysis based upon the minimum three phase bolted fault short circuit current available at the point of service. Submittal data shall not relieve supplier of specified performance requirements. Analysis shall include:
      a. Calculate percent voltage distortion , with respect to fundamental voltage, for all harmonics up to the 48th.
      b. Comparison with IEEE 519 standards for acceptable voltage distortions on such systems.
   4. Submit detailed list of any proposed deviations from these specifications.
   5. Submit experience certification upon request including Owner name, address, and telephone number for systems of similar size and type.

B. OPERATION AND MAINTENANCE MANUALS: Include as part of the equipment operation and maintenance manual.

C. SPARE PARTS LIST: Provide vendor’s name, address, and phone numbers for spare parts.

1.3 PROJECT RECORD DOCUMENTS

A. Submit project record documents.

B. Submit harmonic distortion analysis test results showing actual field measurements of harmonic distortion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products according to the written instructions of manufacturer.

1.5 WARRANTY

A. Provide two years of Manufacturer's warranty covering equipment, software, configuration, and labor from Owner's Acceptance.

1.6 GENERAL DESIGN REQUIREMENTS

A. This design is based upon the named manufacturer, if substitute equipment is offered, the contractor shall be responsible for all modifications including but not limited to components, interconnection wiring, space requirements, and equipment layout. All modifications shall be subject to approval by Engineer and provided at no additional cost to the Owner.

B. Like components of all systems, although for different service, shall be the end products of a single manufacturer.

C. It shall be the responsibility of the Contractor to provide a complete and fully operable adjustable speed controller system for each unit identified elsewhere in the specifications and on the drawings.

1.7 STANDARDS

A. IEEE Standards 519-1992.

B. UL listing/labeling Standard UL508C.

C. CSA

D. EMA ICS 3.1

E. Manufacturer shall be ISO 9001 or ISO 9002 certified.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Allen-Bradley (18-pulse, or 6-pulse with active front-end).

2.2 GENERAL

A. Provide adjustable speed controller systems capable of converting the specified voltage, 3-phase, 60 Hz, input power into variable voltage, adjustable frequency, 3-phase output of suitable capacity and waveform to serve as input power to squirrel cage induction motors.

B. Harmonic Distortion:
   1. The adjustable speed controller systems shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when operated from the same bus.
   2. Individual or simultaneous operation of the adjustable speed controller systems shall not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator in accordance with IEEE 519, 1992.
   3. Maximum total and individual harmonic current distortion limits for each odd harmonic shall not exceed those set forth by IEEE 519, 1992.
   4. If harmonic filters are needed to meet these requirements, then the speed controller supplier shall provide and be responsible for the design and manufacture of the filters. The need for filters shall be identified by the Contractor in the Shop Drawings.

C. Reflected Wave/Harmonics:
   1. If the distance between the speed controller and the driven equipment requires cable terminators, they should be furnished by the speed controller supplier and installed by the contractor. The need for cable terminator(s) or reflected wave traps, shall be identified in the Shop Drawings.

2.3 ADJUSTABLE FREQUENCY DRIVE

A. Environmental
   1. Altitude: 3,300 feet without derating.
   2. Humidity: 5 to 95 percent, non-condensing.
   3. Temperature: 32 to 104 degrees Fahrenheit.

B. Electrical
   1. Input voltage tolerance: 10 percent of rated voltage.
   2. Rated voltage: as shown on drawings and scheduled.
   3. Input frequency: 48 to 62 Hertz.
   4. Displacement power factor: 0.95, provide inductor on units 5 hp and smaller.
   5. Efficiency at rated current and nominal voltage: 97.5 percent.
   6. Maximum short circuit current: 5000 A rms at 600 volts.

C. Control
   1. Method: Sine coded PWM with programmable carrier frequency.
   2. Output voltage: 0 to rated voltage.
   3. Output frequency: 0 to 400 Hz.
   4. Volts per Hertz ratio: fully programmable.

5. Frequency regulation:
    a. Analog input: 0.4 percent of maximum.
    b. Digital input: 0.01 percent of maximum.
6. DC Boost:
    a. Fan mode: two selectable.
    b. Auto mode: eight selectable with independent.
    c. Fixed mode: selectable with independent acceleration and run boosts.
7. Acceleration/deceleration: two independently programmable times, adjustable from 0 to 600 seconds in 0.1 second increments.
8. Intermittent overload capability.
    a. Constant torque: 150 percent of output for one minute.
    b. Variable torque: 115 percent of output for one minute.
9. Proactive current limit:
    a. Constant torque: 20 to 160 percent of rated output.
    b. Variable torque: 20 to 115 percent of rated output.
    c. Inverse time overload: Class 20 protection with speed sensitive response, adjustable from 20 to 115 percent of rated current in 3 speed ranges.

D. Protective features.
1. Detection and trip:
    a. Undervoltage.
    b. Overvoltage.
    c. Overcurrent.
    d. Overtemperature.
    e. External signal.
    f. Output short circuit.
    g. Ground fault.
2. Overcurrent stall.
3. Overvoltage stall.
4. Six alarms.

E. Signal interface:
1. Drive fault contact.
2. Drive run contact.
3. Drive alarm contact.
4. Programmable output contact.
5. Potentiometer input.
6. 0-10 VDC analog input.
7. 4-20 mA analog input.
8. 4-20 mA signal loss response.
9. Analog output, selectable.
10. Analog input conversion.
11. Pulse train input.
12. Encoder feedback closed loop speed control.

F. Programmable Parameters:
1. Dual acceleration/deceleration profiles.
2. Three skip frequencies.
3. DC injection braking.

4. Dynamic braking.
5. Slip compensation.
6. Negative slip compensation.
7. Selectable fault reset tries and time.
8. Electronic thermal overload.
9. S-curve acceleration/deceleration profile.
10. Standard and custom volts-per-hertz curves.
11. Traverse function.
12. Proactive current limit.
13. Four event fault memory.
14. Flying start.
15. Automatic DC boost.
16. Seven preset speeds.
17. Phase lock loop.

G. Human Interface Module- Keypad
1. Display faults in English language:
   a. Power fault.
   b. Control fault.
   c. Logic fault.
   d. Software fault.
   e. Protective fault.
2. Settings and indication
   a. Adjustable Speed/Constant Speed Selection (systems with bypass)
   b. Bypass Run Indication (systems with bypass)
   c. Manual/Automatic Selection
   d. Manual Pushbutton Start/Stop
   e. Speed Indication
   f. Speed Setpoint Indication
   g. Inverter Failure Indication
   h. Inverter Run Indication
   i. Manual Speed Control
   j. Alarm/Cutout Reset Switch
   k. Output Current Indication (each phase)
   l. Output Voltage Indication (each phase)
   m. Output Frequency Indication (each phase)
   n. Output Kilowatts Indication (each phase)
   o. Drive Temperature Indication
   p. Motor RPM Indication
3. Allow control of speed controller with start-stop function keys and digital speed potentiometers.
4. Allow programming of all programmable parameters.
5. Door mounted on front of enclosure. Provide required interface cable.

H. Constant or variable torque. Coordinate with the specification of the driven equipment.

2.4 OVERCURRENT PROTECTION

A. Provide thermal magnetic main circuit breaker of scheduled ampacity.

B. UL short circuit withstand rating shall be 42,000A minimum.

C. Provide a through-the-door circuit breaker operator, which is interlocked with the door mechanism and is lockable in the off position. Provide an interlock defeat mechanism which allows authorized personnel to enter the enclosure while circuit breaker is in the on position.

2.5 PILOT CONTROL DEVICES

A. Provide the following front of panel mounted pilot devices:
   1. Human interface Module.

B. Provide the following interface signals, prewired to terminal block for field connections:
   1. Remote START input.
   2. Remote TRIP input.
   3. Controller ON output.
   4. Controller in REMOTE control output.
   5. Controller FAILED output.
   6. Remote 4-20 mA speed demand input.
   7. 4-20 mA speed indication output.
   8. Motor shutdown protection (from auxiliary contact of disconnect switch local to motor).

2.6 ADDITIONAL REQUIREMENTS

A. The ASCs shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 80% at 50% speed and load.

B. The ASCs shall maintain the line side displacement power factor no less then 0.95 regardless of speed and load.

C. The ASCs shall have a one minute overload current rating of 110% for Variable Torque Drives.

D. The ASCs shall have a one minute overload current rating of 150% for Constant Torque Drives.

E. The ASCs shall be able to start into a spinning motor. Each ASC shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the AFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the setpoint speed.

F. The ASCs shall have fully adjustable acceleration and deceleration controls.

G. The ASCs shall provide automatic phase rebalance to rebalance 3 phase load currents upset by voltage unbalance.

2.7 ENCLOSURE

A. Refer to electrical plans for enclosure type (i.e. wall-mounted or floor standing).

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation by Others in accordance with written instructions from manufacturer in location shown on drawings.

B. Protect panels while construction is underway.

C. Clean panels and touch up paint when construction is complete.

D. Adjust overload devices.

E. Adjust all programmable controller features, including but not limited to auto restart parameters. The controller system must automatically restart after a power fail condition.

F. Provide engraved nameplates. Use equipment tag names shown on the plans. Refer to Section 16482.

G. Provide typed label inside each unit identifying motors served, nameplate horsepower, full load current, code letter, service factor, voltage/phase rating, and overload setting.

H. Provide typed label inside each unit identifying configured valves for all programmable drive parameters.

3.2 QUALITY CONTROL AND TESTING

A. Inspect and test each unit in accordance with NEMA ICS. 2, Division 16, and Vendor Manuals.

B. Prior to each drive application startup, all equipment shall be inspected for proper alignment and proper connection.

C. Short commercial tests shall be made, including no-load current at rated voltage, full load current, and locked rotor current.

D. Provide test of motor cables prior to energizing each new ASC. ASC manufacturer to provide test procedure.

E. Provide a pre-service test operation of the drive and motor in all normal modes of operation to test start, stop, jog, run, acceleration, and deceleration in local and remote modes.

F. Provide certified copies of test reports on each drive, to the Engineer for review.

3.3 TRAINING

A. The Contractor shall provide a training session for up to 4 Owner's representatives for 2 normal workdays with a maximum of 2 trips at a job site location determined by the Owner. Training and instruction time shall be in addition to that required for start-up services.

B. The training shall be conducted by the manufacturer's qualified representative.

C. The training program shall consist of the following:
   1. Instructions on the proper operation of the equipment.
   2. Instructions on the proper maintenance of the equipment.

END OF SECTION

SECTION 16501

LAMPS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. The Contractor shall furnish and install the initial fill of lamps for all lighting fixtures. Lamps shall be of size and type as called for in the lighting fixture schedule and as recommended by the fixture manufacturer. Where scheduled lamp types differs from that recommended by the manufacturer, the Contractor shall furnish lamps as recommended by the lighting fixture manufacturer.

1.3 WARRANTY

A. All lamps shall be guaranteed for 50% of rated life after date of final acceptance.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric Co.

B. Philips

C. Sylvania

Special Manufacturers as noted on the lighting fixture schedule.

2.2 FLUORESCENT LAMPS

A. All fluorescent lamps to be the color designation as specified in the lighting fixture schedule.

B. All rapid start lamps shall be siliconized at the factory.

C. All 4'-0" and 3'-0" rapid start lamps installed in interior heated locations shall be energy saving type. Rapid start lamps installed in unheated spaces or areas with low ambient temperatures (60 degrees F or less) shall be standard 400 ma lamps.

D. All lamps shall be guaranteed for compatibility with specified ballast.

2.3 HIGH INTENSITY DISCHARGE LAMPS (HID)

A. All HID lamps used for interior use shall be coated lamps unless noted otherwise on the drawings.

B. HID lamps shall be furnished for proper burning position with the fixture and installation specified so as to help achieve its rated lamp life.

C. Where metal halide lamps are specified in a non-enclosed fixture, lamps shall be furnished that are acceptable for use in such fixtures. Do not furnish lamps with warning notices requiring enclosed fixture application, unless an enclosed fixture is specified.

D. Furnish lamps with the proper phosphor coating specified to achieve the apparent color temperature of the specified lamp replace all lamps with a noticeable color shift.

PART 3 EXECUTION

3.1 DELIVERY AND STORAGE

A. All lamps shall be new and delivered to the job in sealed cartons and protected from dirt and dust during storage on the project.

3.2 INSTALLATION

A. Lamps will be taken directly from the cartons and installed in the fixtures with special care so that they do not become dusty and are not soiled in the process.

3.3 REPLACEMENT

A. All lamps not functioning properly at final inspection or lamps where light output is noticeably reduced, shall be replaced by the Contractor.

END OF SECTION

SECTION 16510

LIGHTING FIXTURES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide and install lighting fixtures and related accessories as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the following regulatory agencies;
1. National Fire Protection Association (NFPA) Chapter 70 - National Electric Code (NEC) and Wisconsin Amendments thereto.
2. Underwriters' Laboratories, Inc.(UL).
3. Conform to the standards of the following agencies:
4. National Electrical Manufacturers Association (NEMA).
5. Certified Ballast Manufacturers Association (CBM).
6. American National Standards Institute (ANSI), Standard C82.1.

1.4 SHOP DRAWING SUBMITTALS

A. Submit manufacturer's printed data on lighting fixtures.

B. Submit fixture shop drawings in booklet form with index and a separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with specified fixture and accessories clearly indicated on each sheet.

C. Shop drawings for all project light fixtures shall be submitted to the Engineer as a single submittal. It shall be the Contractor's responsibility to combine drawings from his different distributors to produce a single, complete submittal to the Engineer. Partial submittals will be rejected without review except that partial resubmittals of rejected fixtures will be allowed.

D. Submit copy of UL test report if requested by Engineer. Include the following information as a minimum:
1. Dimensional information.
2. Description of the fixture construction.
3. Recommended lamps for use in that particular fixture.
4. Photometric test reports.
5. Any warnings regarding special requirements regarding the use of the lighting fixture.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURES

A. Provide lighting fixtures of the size, type, and rating indicated in "Lighting Fixture Schedule" complete with lamps, lampholders, reflectors, ballasts, starters, wiring and other equipment required for a complete working installation.

B. Fixture catalog numbers do not necessarily include all accessories required to complete the installation. Catalog numbers used in the Lighting Fixture Schedule are used to designate the fixture series, size and lamping requirements. Refer to the lighting fixture schedule notes for additional requirements.

C. Provide proper trim for each fixture as required for the various types of ceiling being installed throughout project. Provide the necessary plaster frames, fixture ends, caps, suspension units, mounting brackets, and/or other auxiliary parts required to complete the fixture installation.

2.2 FLUORESCENT FIXTURES

A. Fabricate from sheet steel, die-formed to provide rigidity.

B. The color finish of each surface or pendant mounted lighting fixture is to be verified with the Engineer at the time of shop drawing review.

C. Lens panels for fluorescent troffers shall be framed and be equipped with hinge and latch. Equip frames and louvers with retaining means to support frame during relamping.

D. Design fluorescent rapid start fixtures, 40W and smaller, to incorporate a grounded metal starting aid such as reflector, ballast channel strip, at least 1 in. wide over full length of lamp and within maximum ½ in. distance from lamp per ANSI C82.1.

E. Design fixtures such that case temperature of ballast does not exceed 90°C.

2.3 HIGH INTENSITY DISCHARGE (HID) FIXTURES

A. Include a prewired integral ballast and optical assembly.

B. Suitable for continuous service at location shown in an ambient temperature of 40°C.

C. Outdoor fixtures shall be capable of operation at -20°F.

D. Ballast housing and structural parts including mounting devices shall be cast aluminum and include a provision for field mounting of safety chains.

E. Optical assembly shall be hinged and latched for lamp access.

F. Lampholders shall be porcelain with a nickel plated brass screw shell for medium and mogul base lamps.

G. Fixtures utilizing metal halide lamps shall be enclosed to prevent contents of the lamp from falling out of the fixture in the event of a violent lamp failure. Open aperture recess metal halide downlights shall contain a clear glass shatter guard below the lamp.

2.4 LENSES

A. Plastic fixture lenses and diffusers, 100% virgin acrylic material. Lenses minimum .125 average thickness.

2.5 STEMS

A. Where stems are furnished by fixture manufacturer, he shall verify length prior to releasing for shipment.

B. Where stems are furnished by Contractor, he shall verify length prior to installation.

C. Suspended fixtures shall have swivel type aligner hangers in ceiling outlet boxes to ensure plumb suspension.

D. Exit fixtures shall be installed so that line of sight is not obstructed.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which lighting fixtures are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Verify ceiling system compatibility with recessed fixture mounting before releasing the order for manufacture.

3.2 INSTALLATION

A. Install lighting fixtures of types indicated where shown on drawings and at indicated heights.

B. Install in accordance with manufacturer's written instructions.

C. Fasten fixtures securely to indicated structural support members.

D. Install pendant fixtures plumb.

E. Provide proper bushings for wire entrances. Ground fixture chassis to conduit system.

F. Coordinate with trades so lighting fixtures are properly aligned with items such as diffusers, grilles, and speakers. If necessary, relocate fixtures as directed so there will be no conflict with other equipment.

G. Mount stem mounted fixtures with swivel aligners and stem lengths as required. Verify stem lengths.

H. Make fixture holes for wire entrance with knock-out punches or hole saw, remove burrs. Do not cut holes with tin snips.

I. Care shall be taken in placement of outlets and surface-mounted fixtures to maintain alignment, spacings, layout, and general arrangement shown on drawings. Contractor may vary these dimensions slightly in order to clear obstructions. Any major changes in the arrangement must be approved by Engineer.

J. Install tandem fixtures in continuous rows providing that finished appearance conforms to appearance of individual units.

K. Align and plumb rows of light fixtures.

L. Mount wall and ceiling fixtures independent and secure so that they are not dependent on finish for support and cannot be rotated or displaced.

M. Maintain clearances as required in Section 410.66 of the NEC. Notify Engineer of any conflict, prior to rough in.

3.3 FIXTURE SUPPORTS

A. See Section 16190 for fixture support items such as devices procedures, and retaining clips.

B. Surface or pendant mounted lighting fixtures weighing in excess of 25 pounds shall be securely supported to the outlet box through the use of a fixture stud. The stud shall attach to the box through a knockout in the top of the box. Fixture support shall not be solely dependant on the ears of the box.

C. Securely attach outlet boxes to the building structure either directly to the structure or through the use a threaded rod or steel channel.

3.4 ADJUST AND CLEAN

A. Clean lighting fixtures of dirt and debris prior to acceptance. Cleaning shall include lamps, reflectors, lenses, louvers and exposed trims and housing.

B. Protect installed fixtures from damage during the construction period

C. Aim adjustable fixtures to satisfaction of Engineer. Adjustable exterior lighting fixtures, such as floodlights, shall be aimed after dark.

D. Remove conspicuous trade labels.

3.5 FIELD QUALITY CONTROL

A. At time of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by Engineer.

3.6 PRODUCT STORAGE AND HANDLING

A. Handle lighting fixtures carefully to prevent breakage, denting, and scoring finish.

B. Do not install damaged lighting fixtures.

C. Do not repair damaged fixtures; replace and return damaged units to equipment manufacturer for repair.

D. Store lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

3.7 JOB CONDITIONS

A. Contractor shall determine that ceiling suspension system is adequately supported to receive and support the lighting fixtures. Where deemed inadequate, do not install fixtures until additional support has been provided.

B. Verify local codes and ordinances that may pertain to installation and aiming of exterior fixtures. Notify Engineer prior to Bid time if problems are encountered.

END OF SECTION

SECTION 16550

MOTION DETECTORS - SECURITY

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide motion detectors for the automatic sensing of unauthorized personnel in building spaces, as indicated on the drawings and as specified herein. Accessory components, such as low voltage transformers and mounting brackets shall be furnished as required for a complete and fully-operation system, weather shown on the plans or not.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Watt Stopper

B. Or Equal. Listing of a manufacturer does not guarantee approval. Manufacturers must meet requirements listed below to be considered acceptable.

2.2 CEILING MOUNTED MOTION DETECTORS

A. Passive infrared sensing technology, and ultrasonic technology to reduce/eliminate false triggers.

B. Shall operate on 24 VDC. Each detector shall provide one Form C output (one normally open contact and one normally closed contact), rated at 1 amp @ 24 VDC. Output relay shall change state when both the infrared and ultrasonic technologies sense motion.

C. Time delay of output relay shall be adjustable from 15 seconds to 30 minutes.

D. Unit sensitivity setting. Shall be adjustable.

E. Unit shall include an LED to indicate operation of each technology.

F. Coverage pattern as required for proper performance: wide angle for use in rooms and long range for use in corridors.

G. Color and coverplate and device shall be white.

PART 3 EXECUTION

3.1 GENERAL

A. Occupancy sensors are to sense motion in the areas shown on the drawings. The Contractor is to adjust the sensitivity for best performance in accordance with manufacturer's recommendations.

B. All low voltage wiring for this system may be installed exposed above accessible ceilings or in wall cavities. All cable installed in return plenum areas shall be Teflon jacketed or rated for such use. Exposed cable shall be supported every 5 feet minimum via bridal clamps or tie wraps.

C. Transformers (power-packs) shall be powered from a new circuit breaker at the local lighting distribution panel.

D. Contractor may wire detectors in series up to limit allowed by manufacturer. Output signal(s) shall terminate at the building's local control panel (LCP).

END OF SECTION

SECTION 16620

STANDBY POWER GENERATOR

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 0 and Division 1 shall govern work in this Section.

1.2 DESCRIPTION

A. Where indicated on the plans, provide a diesel powered, standby, electrical power generator. Installation shall include sub-base fuel tank, fuel fill station, piping, and all accessories.

1.3 QUALITY ASSURANCE

A. Equipment and installation shall conform to the requirements of the following agencies:
   1. U.S. Environmental Protection Agency (EPA): Design Criteria of Mechanical, Electrical, and Fluid System and Component Reliability.

B. National Fire Protection Association (NFPA)
   1. NFPA-70 - National Electrical Code (NEC), and Wisconsin amendments thereto.
   2. NFPA - 76A Essential Electrical Systems for Health Care Facilities.
   3. NFPA-101 Life Safety Code.

C. Underwriter's Laboratories (UL). Electrical Construction Material List.
   1. U.L. Listed to standard #2200.

D. Local Codes and Ordinances
   1. American National Standards Institute ANSI Y32.2.
   2. Institute of Electronic and Electrical Engineers (IEEE).
   3. National Electrical Manufacturers Association (NEMA).

E. The following production tests shall be completed on the engine/generator assembly.
   1. Mechanical operation test.
   2. Ground tests.
   3. Control wiring tests.
   4. Operation test.

F. Engine/generator set shall be product of a manufacturer who shall warranty complete engine/generator package with accessories as described herein.

1.4 SUBMITTALS

A. Shop drawings: Submit under provisions of Division 1, including the following:
   1. Manufacturer's cut sheets of all system equipment. Information included on cut sheets shall be sufficient to determine compliance with these specifications.

a. Dimensional drawings of all system equipment. As a minimum, drawings shall show all critical dimensions and shall show all field connection points. Drawings shall be project-specific. Accessories not being offered for this project shall not be shown on the drawings furnished.

b. Generator room section at a minimum scale of 1/2" = 1'-0". Section line shall be parallel to the long axis of the generator. As a minimum, drawing shall show overall height of installation, muffler and exhaust support details, and exhaust pipe coordination with radiator exhaust duct.

c. Fuel piping isometric with pipe sizes, pipe materials, valves, and calculations shown.

2. Single line diagram in accordance with ANSI Y32.2 indicating connections and controls.

B. Submit test reports including:

1. Certified test reports of prototype, production, and field tests.
2. Submit to the owner, manufacturer's instructions for start-up, performing cleaning, operating, and maintaining standby power systems.

C. Submit operation and maintenance manuals under provisions of Section 01730.

D. Submit certificates of proper installation and operator training (by manufacturer’s representative) under provisions of Section 01445.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle the equipment under the provisions of Division 1.

B. Lift engine/generator using eyes, yokes and skids provided by manufacturer.

C. Do not store indoor type equipment exposed to weather.

D. Protect from work of other trades.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kohler Co.

B. Cummins Onan.

C. Requirements in this specification for generator physical size, fuel supply requirements, engine exhaust requirements, radiator exhaust requirements, etc. are based on a generator of the electrical KW required as distributed by Kohler. By furnishing a generator from a different manufacturer, even if approved on the shop drawings by the engineer, the contractor assumes the responsibility for insuring the unit will fit in the space allocated and that all support systems are adequate for a complete, functioning system. If changes are required to fuel lines, exhaust piping, exhaust ductwork, louvers, etc. from what is

shown on the plans to accommodate the generator being supplied, the contractor shall include any costs associated with these changes in his bid.

2.2 ENGINE/GENERATOR RATINGS

A. Rate standby engine/generator set at not less than 225 kw, standby duty at 0.8 pf, 480V, 3 ph, 4 wire, 60 Hz. Base rating on operation when equipped with operating accessories at 1,000 ft elevation and 27°C. ambient temperature. Ventilating system is designed for maximum 11°C. rise above room ambient of 40°C. maximum.

B. Regulator system filtered to be compatible with and capable of regulating generator output to permit starting of and running of the loads as shown on the drawings, simultaneously with a maximum of 20% voltage dip at locked rotor current with return to steady state in less than 2 sec. Steady state is defined as operation with terminal voltage remaining constant within ± ½ of 1% of rated voltage.

C. Air emission: Generator set shall meet EPA emissions standards.

2.3 ENGINE CONSTRUCTION AND RATINGS

A. Engine speed of 1,800 rpm.

B. Water cooled with unit mounted radiator.

C. Inline four stroke cycle compression ignition diesel.

D. Naturally aspirated.

E. Heavy duty industrial type.

F. No. 2D diesel fuel.

G. 12 v dc positive engagement, solenoid shift, starting motor.

2.4 REQUIRED ACCESSORY EQUIPMENT

A. Governor to maintain frequency regulation not to exceed 1% from no load to full rated load.

B. Lubrication break-in oil.

C. Electric fuel solenoid shut-off valve with standard fuel filter on engine.

D. Oil drain extension through side of skid base.

E. Heavy duty air cleaner.

F. Lube oil filter with replaceable elements.

G. Overspeed cut-out.

H. Low oil pressure cut-out.

I. High coolant temperature cut-out.

J. Flexible fuel connections.

K. Seamless, flanged stainless steel, flexible exhaust connection.

L. Engine coolant heater, 120V, single phase with adjustable thermostat.

M. Welded steel skid type base securely mounted with anchored mounting bolts and with integral spring vibration isolators. The proper quantity and size of spring isolators shall be provided to assure that the isolators are not totally compressed during operation.

2.5 ENGINE COOLING EQUIPMENT

A. Unit Mounted Radiator

B. Pusher type fan.

C. Duct flange.

D. Sized for 50% ethylene-glycol solution at 40°C. ambient and 1,000 ft elevation.

E. Ethylene-glycol antifreeze with rust inhibitor to -40°C.

2.6 GENERATOR CONSTRUCTION

A. 3-ph, 60 Hz.

B. Single bearing.

C. Synchronous type.

D. 12 lead reconnectable.

E. Drip-proof construction.

F. Radio suppression.

G. Class H Insulated.

H. Brushless, direct-connected type exciter with shaft mounted diodes and built-in permanent magnets to eliminate field flashing.

I. SCR type automatic voltage regulator to provide 1% voltage regulation from no load to full load.

J. Application of one-step load of 50% of rated load shall not result in voltage dip of more than 5% with recovery to within ± ½ of 1% in less than 2 sec.

K. Regulator shall be filtered to eliminate the effect of SCR loads on the regulator.

2.7 ENGINE/GENERATOR CONTROLLER

A. NEMA Type 1 enclosure, vibration isolated on generator enclosure.

B. Plug-in design circuitry for quick replacement.

C. Fused DC circuits.

D. Complete 2-wire start/stop control to operate on activation of remote contact from automatic transfer switch.

E. Design starting system for restarting in event of false engine start by permitting engine to completely stop and then re-engage starter.

F. Overcranking protection designed to open cranking circuit after 60-sec (adjustable) if engine fails to start.

G. Circuitry to shut down engine when signals for high coolant temperature, low oil pressure, overcrank or overspeed are received, with reset button.

H. 5 minute time delay on engine shutdown after retransfer to normal to allow unloaded running cool down.

I. Three position automatic/off/test selector switch.

J. Emergency stop switch.

K. Indicating lights to signal
1. Selector switch OFF - Red (flashing).
2. Overcrank - red.
3. High coolant temperature - red.
4. Overspeed - red.
5. Low oil pressure - red.

L. Test button for indicating lights.

M. Voltmeter 3½ inch 2% accuracy, minimum.

N. Ammeter 3½ inch 2% accuracy, minimum.

O. Voltmeter-ammeter phase selector switch.

P. Frequency meter.

Q. Panel illumination lights with on/off switch.

R. Battery charging ammeter.

S. Oil pressure gauge.

T. Coolant temperature gauge.

U. Running time meter.

V. Plug-in voltage regulator with voltage adjusting rheostat.

W. Unpowered normally open auxiliary interlock contacts wired to terminal block.

X. Generator failure signal to remote location.

Y. Generator run signal to remote location.

Z. Two auxiliary interlocks for 120V air louver control.

AA. Line circuit breaker or line sensing field circuit breaker, molded case, resetable type, 3 pole, 100%-rated, 600V, in NEMA 1 enclosure, unit mounted. Circuit breaker shall be UL or CSA listed for use as service equipment.

2.8 STARTING BATTERIES

A. 12 v dc. Quantity as required by manufacturer.

B. Ampere-hour rating as required by factory

C. Lead antimony type.

D. Stranded copper battery cables.

E. Free standing metal rack with acid resistant paint.

2.9 AUTOMATIC BATTERY CHARGER

A. Automatic battery charger shall have a transistor controlled magnetic amplifier circuit to provide continuous taper charging.

B. Maintain constant voltage output with ac line fluctuations of ± 10%.

C. Two ranges, float at 2.17 v dc and equalize at 2.33 v dc.

D. Automatic ac line compensation.

E. Automatic overload protection current limiting.

F. Silicone diode full-wave rectifiers.

G. Automatic surge suppressors.

H. DC ammeter and voltmeter.

I. Fused AC input and DC output.

J. DC output of the battery charger(s) shall be sufficient to recharge the battery system within 8 hours.

K. NEMA 1 enclosure for wall mounting.

2.10 EXHAUST EQUIPMENT

A. Provide Residential Grade exhaust silencer

B. Provide with drain plug at bottom of muffler opposite of exhaust outlet.

C. Exhaust Piping. Stainless steel with condensate drip pocket and drain valve in accordance with Division 15 specifications.

D. Insulate in accordance with Division 15 specifications.

E. Provide aluminum cover over insulation.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive engine/generator to assure adequate clearance for engine/generator installation.

B. Examine room air intake and exhaust to assure adequate air requirements

C. Verify that mounting area is level and free of irregularities.

D. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Engine - Generator
1. Install engine/generator in accordance with manufacturer's written instructions and NEC.
2. Lubrication and break-in oil to be supplied and installed by supplier's or manufacturer's technician at time of start-up.
3. Anti-freeze with rust inhibitor (set to -40°C.) to be supplied and installed by supplier's or manufacturer's technician at time of startup.

B. Starting Batteries and Charger
1. Locate freestanding battery rack near engine starter and connect cables with suitable lugs.
2. Wall mount battery charger near batteries and extend battery charging wires in conduit under floor.

C. Exhaust System

1. Install a stainless-steel piping system in accordance with Division 15.
2. Provide with drip pocket to collect condensation and drain valve.
3. Size pipe as recommended by engine manufacturer.
4. Pitch horizontal piping downward away from engine, minimum of 8 ft above floor, with outside rainguard. Provide stainless-steel exhaust pipe wall thimble with insulation and heat dissipation chamber in accordance with NFPA 37, Chapter 7.
5. Insulate silencer and piping. Do not insulate flexible connection.
6. Cover insulation with aluminum cover.
7. Use sweep elbows on exhaust system. Minimum inside radius shall be three times the inside pipe diameter.

D. Fuel Supply Equipment

1. Contractor shall provide fuel fill piping, fuel vent piping, and piping for excess fuel (overflow). Refer to plans for location on the building's exterior wall for these three pipe penetrations.
2. Install piping in accordance with industry standards, NFPA 54, and EPA regulations, and in accordance with Division 15.
3. All wiring to sensors shall be in conduit.
4. Liquid and vapor sensors shall be installed per manufacturer's recommendations.
5. Valves indicated shall be ball valve type.
6. Install pipe in accordance with industry standards.
7. Pitch vent and fill lines toward tank.

3.3 FIELD TESTS PRIOR TO START UP

A. Megger check of phase-to-phase and phase-to-ground insulation levels. Do not megger check solid state equipment.

B. Ground continuity.

C. Short circuit.

D. Perform additional tests according to engine/generator manufacturer's instruction.

3.4 CLEANING

A. Clean equipment and equipment room floor prior to start- up.

B. Touch up scratches or marred surfaces to match original finish.

3.5 SUPPLIER'S OR MANUFACTURER'S SERVICES

A. Retain services of engine/generator set manufacturer's factory trained technician employed by engine/generator set manufacturer or his authorized distributor to perform following services:

1. Installation Services:

a. Visit project site to review installation requirements with Contractors involved. Visit shall be made prior to permanently installing equipment and/or making mechanical or electrical connections.

b. Visit site and meet with all concerned Contractor s to ensure installation is properly coordinated. Electrical Contractor to coordinate meeting to ensure presence of all parties concerned.

2. Testing Services.

a. In addition to normal factory tests, provide a 3-phase portable load bank at project site. Load bank test shall occur after equipment has been permanently installed and shall be performed in the presence of Engineer:

b. Connect engine/generator set to the load bank and conduct a 2-hr test

c. During two-hour test, vary load on generator from 10% to 100% to determine that voltage, frequency, capacity, fuel, combustion air, cooling, and ventilation systems are adequate. Step load during test as follows.

1) 10% load for 15 min.
2) 25% load for 15 min.
3) 50% load for 15 min.
4) 75% load for 15 min.
5) 100% load for 1 hr.

d. Apply each increment of load in one step.

e. During the test the following performance criteria shall be met.

f. Maximum voltage dip of 20%.

g. Recovery of less than 2 sec to maintain voltage and frequency as specified.

3. Submit release signed by supplier and Contractor to Owner and Engineer with deficiencies noted, if any, along with proposed solutions.

4. Include a minimum of six simulated power failures in the presence of transfer switch manufacturer's start-up representative.

5. Test remotely connected engine/generator status indication signals.

6. Test transfer switch.

7. Instructional Services. Provide a comprehensive demonstration to Owner or maintenance personnel and Engineer of system maintenance and operation after load bank test and after engine/generator set is electrically connected to automatic transfer switch.

END OF SECTION

SECTION 16621

AUTOMATIC TRANSFER EQUIPMENT

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 0 and Division 1 shall govern work in this Section.

1.2 DESCRIPTION

A. Provide a factory assembled, metal enclosed, automatic transfer switch for distribution and control of power from normal power supply or from output of a standby engine/generator upon failure of normal power supply to outgoing feeder terminals and automatic retransfer back to normal power supply upon resumption of normal service.

1.3 QUALITY ASSURANCE

A. Equipment shall comply with the requirements of the following Regulatory Agencies:
1. U.S. Environmental Protection Agency (EPA). Design criteria for Mechanical, Electrical, and Fluid System and Component Reliability.
2. National Fire Protection Association (NFPA)
3. Underwriters' Laboratories, Inc. (UL)
4. Local Codes and Ordinances
5. American National Standards Institute (ANSI)
6. National Electrical Manufacturers Association (NEMA). Standard ICS.
7. National Electrical Code (N.E.C.)
8. Occupational Safety and Health Administration (O.S.H.A.)

B. Perform the following production tests on the completed transfer switch:
1. Operation of individual components.
2. Correct overall sequence of operation.
3. Transfer time.
4. Voltage.
5. Time delay settings.
6. Dielectric strength test per NEMA Standard ICS 1-109.05.

C. A prototype of the switch shall have been subjected to and have passed the following tests by a certified independent testing laboratory.
1. Overload and endurance at 480 VAC per Table 21.2 and 23.2 of UL 1008 when enclosed per Table 1.6.

D. Provide with full rated neutral bar.

E. The switch shall have passed tests per paragraph 25 of UL 1008 to withstand current @ 480 VAC and X/R ratio of 6.6 or less using MCB upstream of the ATS.

F. The entire transfer switch and relay plate assembly should be capable of withstanding a 2500 volt crest transient per IEEE standard 472-1974. The transient voltage test shall be conducted across the normal source terminals, the emergency source terminals, and between opposite normal and emergency source terminals. A certified laboratory test report from an independent testing laboratory shall be furnished to verify conformance.

1.4 SUBMITTALS

A. Shop drawings shall indicate transfer switch, control panel and enclosure dimensions, control arrangements, and singleline diagrams in accordance with ANSI Y 32.2 indicating connections and controls.

B. Submit manufacturer's written recommendations for storage and protection, installation instructions, and field test requirements.

C. Submit manufacturer's instructions for start-up, performing cleaning, operating, and maintaining transfer switch systems.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kohler.

B. Russelectric.

C. Engineer-approved equal.

2.2 TRANSFER SWITCH RATINGS

A. 400 Amp, 480Y/277 volt, 3 phase, 4 wire.

B. Switch shall be 3 pole with solid neutral. Switch shall be closed-transition style and shall be service-entrance rated.

C. Minimum Short Circuit Rating: 42,000 rms sym amps.

D. NEMA 12 enclosure.

2.3 EQUIPMENT SWITCH CONSTRUCTION

A. Transfer switch is to be mechanically held, electrically operated by a single solenoid or motor mechanism momentarily energized from the source to which the load is being transferred.

B. The switch shall be rated for continuous duty and shall be inherently double throw, mechanically interlocked to ensure only one of two possible positions, normal or emergency.

C. Load carrying parts shall have full 600-volt insulation and main contacts, as well as arcing contacts and shall be replaceable without disassembly of the operating mechanism or disconnection of power conductors.

D. The transfer switch shall consist of a power transfer module and a control module separately mounted. Control module shall be mounted on the inside surface of the enclosure door to facilitate safe adjustment and service. Harnessing between transfer module and control module shall have built-in disconnect.

E. The automatic transfer switch shall be suitable for use in emergency systems, listed by Underwriter's Laboratories under Standard 1008 for total system transfer.

F. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriters' Laboratories, Inc. Standard UL-508.

G. The transfer switch shall be double throw, actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple over center type linkage with a total transfer time not to exceed ½ second. The transfer switches shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

H. The normal and emergency contact shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contact shall be mechanically locked in position in both the normal and emergency positions without use of hooks, latches, magnets, or springs; and shall be silver tungsten alloy protected by arcing contacts with magnetic blowouts on each pole. Interlocked molded case circuit breakers or contactors are not acceptable.

I. The transfer switches shall be equipped with a manual operator per paragraph 14 of UL standard 1008 that is designed to prevent injury to the operating personnel if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electric operator to prevent a flashover from switching the main contacts slowly. The manual operator shall be designed to operate without opening the enclosure door. The switch assembly shall be designed such that manual operation will not put the person standing in front of it at risk of Arc Flash. A mechanical visual indicator for the switch position shall be provided.

J. All relay, timers, control wiring and accessories shall be front accessible. Test switch and pilot lights shall be on front of cabinet door. The voltage sensing relays and all adjustable times shall be capable of being adjusted while energized, through calibrated dials. All control wire terminals shall be ring or locking spade terminals.

K. All wiring shall be identified by tubular sleeve-type markers.

L. ARC FLASH WARNING LABELS

1. All transfer switches shall include a warning label indicating the risk of arc flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

2.4 ACCESSORIES

A. The control panel shall meet or exceed the voltage surge withstand capacity in accordance with IEEE Std. 472-1974 and impulse voltage withstand test in accordance with NEMA Std. ICS 1-109 and shall be supplied with the following accessories:

1. Engine starting contacts, gold plated for low voltage DC service. Contacts to close on failure of normal source to initiate engine starting.
2. Auxiliary contact to open when normal fails.
3. Independent voltage and frequency sensing network to prevent transfer to emergency until generator voltage is 90% of nominal and generator frequency is 95% of nominal.
4. Time delay on engine starting .5 to 3 second adjustable time delay to ignore momentary outages, factory set at 3 seconds.
5. Adjustable time delay on retransfer to normal (motor driven type - 0 to 30 minutes) fixed 5 minute unloaded running time for cool-down of stand-by plant after retransfer to normal.
6. Solid State Close Differential Relay protection on normal. Three Close Differential Sensing Relays factory set for 90% pickup, 80% dropout. Relays are adjustable in the field.
7. Test switch momentary type to be mounted on cabinet. Provides for testing operation of emergency plant and transfer switch (simulates normal power failure).
8. Green Pilot Light for indicating switch in normal position.
9. Red Pilot Light for indicating switch in emergency position.
10. Auxiliary Contact on main shaft (closed on normal).
11. Auxiliary Contact on main shaft (closed on emergency).
12. Assembly shall include an in-phase monitor/controller. The controller shall be bi-directional, operating independent of line voltage to assure transfer between live sources in either direction within a 20 degree phase angle difference (to protect system from abnormal motor inrush currents).

PART 3 EXECUTION

3.1 INSPECTION

A. Examine area to receive transfer switch to assure adequate clearance for transfer switch installation.

B. Start work only after unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install transfer switch in accordance with manufacturer's written instructions and NEC.

B. Contractor shall provide control wiring as required between transfer switch starting contacts and generator. Starting contacts for multiple transfer switches served from the same generator shall be wired in parallel. Control wiring shall be in conduit.

3.3 FIELD QUALITY CONTROL

A. Field Test Prior to Start-up.

B. Megger check of phase-to-phase and phase-to-ground insulation levels.

C. Continuity.

D. Do not megger check solid state equipment.

E. Perform tests according to transfer switch manufacturer's instructions.

3.4 ADJUSTMENTS AND CLEANING

A. Check adjustment of mechanism for free mechanical movement.

B. Tighten connections and mechanical fasteners.

C. Touch up scratched or marred surfaces to match original finish.

3.5 TRANSFER SWITCH START-UP

A. Retain services of transfer switch manufacturer's factory trained technician to perform following services:

B. After engine/generator load bank test and after engine/generator set is electrically connected to automatic transfer switch, provide comprehensive demonstration of system maintenance and operation to OWNER or OWNER'S maintenance personnel.

C. Include minimum of six simulated power failures.

3.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not store indoor type equipment exposed to weather.

B. Protect system equipment from work of other trades.

END OF SECTION

SECTION 16960

TESTING ELECTRICAL SYSTEM

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 1 shall govern work under this Section.

1.2 SCOPE

A. Assure that electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.

1.3 ITEMS TO BE TESTED

A. Panelboards

B. Transformers

C. Circuit Breakers

D. Grounding Systems

E. Standby Generator System

F. Automatic Transfer Switch

G. Motors

1.4 QUALITY ASSURANCE

A. Comply with the requirements of the following regulatory agencies;
1. National Fire Protection Association (NFPA), chapter 70 National Electrical Code (NEC) and Wisconsin amendments thereto.
2. Underwriters' Laboratories, Inc. (UL).
3. O.S.H.A.

B. Conform to the standards of the following agencies;
1. National Electrical Manufacturer's Association (NEMA)
2. American Society for Testing and Materials (ASTM)
3. Institute of Electrical and Electronic Engineers (IEEE)
4. National Electrical Testing Association (NETA)
5. Insulated Power Cable Engineers Association (IPCEA)

C. Inspections and tests shall utilize the following references:
1. Project design specifications.
2. Project design drawings.
3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.5 TEST REPORT SUBMITTALS

A. Seven copies of complete testing report.

B. Submit report no later than 30-days after completion of testing.

C. Submit proof of testing agency qualification.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Test work and equipment installed to ensure its proper and safe operation in accordance with intent of drawings and specifications.

B. Check interlocking and automatic control sequences and test operation of safety and protective devices.

C. Correct defects.

D. Cooperate with electrical utility, supplier's, and manufacturer's representatives in order to achieve proper and intended operation of equipment.

E. Test, adjust and record operating voltages at each system level before energizing branch circuits.

F. Replace devices and equipment damaged due to failure to comply with this requirement.

G. Balance load among feeders conductors at each panelboard, switchboard, or substation, and reconnect loads as may be necessary to obtain a reasonable balance of load on each phase. Electrical unbalance shall not exceed 7½% between phases. Submit test results on the appropriate sheet found at the end of this section.

3.2 TRANSFORMERS - LIGHTING

A. Visual and Mechanical Inspection
   1. Inspect for physical damage.
   2. Verify equipment is supplied and connected in accordance with design specifications.
   3. Check tightness of external bolted electrical joints in accordance with manufacturer's instructions.
   4. Perform specific inspection and mechanical tests as recommended by manufacturer.

B. Electrical Tests
   1. Insulation resistance tests shall be performed winding-to-winding and winding-to-ground. Appropriate guard circuit shall be utilized over all bushings. Test

voltage and minimum acceptable values shall be in accordance with above subparagraph.

2. Submit test results on the appropriate sheet found at the end of this section.

C. Test Values

1. Insulation Resistance Test: Test voltages to be in accordance with values established for switchboard assemblies.
2. Turns ratio test results shall not deviate more than ½ of 1% from calculated ratio.

D. Testing shall occur prior to making primary and secondary feeder connections (i.e. prior to placing in service).

3.3 CIRCUIT BREAKERS - LOW VOLTAGE

A. Visual and Mechanical Inspection

1. Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.
2. Operate circuit breaker to ensure smooth operation.
3. Inspect case for cracks or other defects.
4. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

3.4 GROUNDING SYSTEMS

A. Inspect ground system for compliance with drawings and specifications.

B. Electrical Tests

1. Fall of Potential test per IEEE Standard No. 81, Section 9.04 on main grounding electrode or system.
2. Two Point Method test per IEEE Standard No. 81, Section 9.03, to determine ground resistance between main grounding system, and major electrical equipment frame, system neutral and/or derived neutral points.
3. Alternate to the Two Point Method.
   a. Ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point.
   b. This test shall be made by passing a minimum of 10-amp dc current between ground reference system and ground point to be tested.
   c. Voltage drop shall be measured and resistance calculated by voltage drop method.

3.5 FEEDERS

A. Each feeder shall be megger tested for insulation resistance.

B. Submit test results on the appropriate sheet found at the end of this section.

3.6 MOTORS

A. Motor testing shall be performed as specified in Section 16481.

B. Submit test results on the appropriate sheet found at the end of this section.

3.7 STANDBY GENERATOR SYSTEM

A. Witness the entire load test and verify test results.

3.8 AUTOMATIC TRANSFER EQUIPMENT

A. Witness load test and verify test results.

END OF SECTION

PANEL/TRANSFER SWITCH DESIGNATION_____

MEGGER TEST RESULTS

A-B Phase _____

B-C Phase _____

C-A Phase _____

A-Ground _____

B-Ground _____

C-Ground _____

Bolts Torqued _____

_____

Visual Inspection Comments:

Tested By _____

Date Tested _____

Time of Day _____

TRANSFORMER DESIGNATION_____

RESISTANCE LEVELS

A-B Phase _____

B-C Phase _____

C-A Phase _____

A-Ground _____

B-Ground _____

C-Ground _____

Primary Tap Settings _____

Secondary Tap Settings _____

Bolts Tightened

Visual Inspection Comments:

Tested By _____

Date Tested _____

Time of Day _____

FEEDER FROM _____ TO _____

Phase conductor size _____

Applied Voltage _____

Resistance Reading _____

Tested By _____

Date Tested _____

Time of Day _____

FEEDER FROM _____ TO _____

LOAD IN AMPS

Phase A _____

Phase B _____

Phase C _____

Phase conductor size _____

Tested By _____

Date Tested _____

Time of Day _____

Was Balancing Required? _____ Yes _____ No

ELECT MOTOR TAG # _____

HORSEPOWER _____

NAMEPLATE DATA:

Overload Relay Type _____

Protective Relay Setting _____

Voltage Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Current Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Direction of rotation (clockwise)(counterclockwise)

END OF SECTION

Information To Build On
Engineering • Consulting • Testing

October 1, 2015

Village of Grafton
Water and Wastewater Utility
1900 Ninth Avenue
Village of Grafton, WI 53024

Attn: Mr. Timothy Nennig
Utilities Superintendent

Re: Geotechnical Exploration Report
Proposed Road Reconstruction, and Lift Station, Utility, and Culvert Construction
River Bend Road and 17th Avenue
Village of Grafton, Wisconsin
Grafton Project No. RBR-2015
PSI Report No.: 00521331

Dear Mr. Nennig:

This letter presents the results of Professional Service Industries, Inc. (PSI) geotechnical exploration for the proposed Road Reconstruction, and Lift Station, Utility, and Culvert Construction, in the Village of Grafton, Wisconsin. This report includes the results of field and laboratory testing and recommendations for the roadway reconstruction, utility and lift station construction, and culvert replacement.

PSI appreciates the opportunity to perform this study and looks forward to continuing our participation during the design and construction phases of this project. If you have questions pertaining to this report, or if PSI may be of further service, please contact us at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Bradley J. Broback, P.E.
Project Engineer
Geotechnical Services

WISCONSIN BRADLEY J. BROBACK E-38787-006 WAUKESHA WI PROFESSIONAL ENGINEER

Ted A. Cera, P.E.
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The above Professional Engineering Seal and signature is an electronic reproduction of the original seal and signature. An original hard copy can be sent if requested. This electronic reproduction shall not be construed as an original or certified document.

PAVEMENT EXPLORATION SERVICES REPORT

For the:

Proposed Road Reconstruction, and Lift Station, Utility, and Culvert Construction
River Bend Road and 17th Avenue
Village of Grafton, Wisconsin

Prepared for:

Village of Grafton
Water and Wastewater Utility
1900 Ninth Avenue
Village of Grafton, WI 53024

Prepared by:

Professional Service Industries, Inc.
821 Corporate Court
Waukesha, Wisconsin 53189
Phone (262) 521-2125
Fax (262) 521-2471

Grafton Project No. RBR-2015
PSI Report Number: 00521331

October 1, 2015

Information To Build On
Engineering • Consulting • Testing

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Information To Build On

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PROJECT INFORMATION

Project Authorization

The following table summarizes, in chronological order, the Project Authorization History for the services performed and represented in this report by Professional Service Industries, Inc. (PSI).

DOCUMENT AND REFERENCE NUMBER	DATE	SOURCE OF REQUEST	AUTHOR OR AGENT & TITLE
PSI Proposal Number: PO-156577	7/7/2015	PSI	Paul J. Koszarek, P.E. David M. Barndt, P.E.
Notice to Proceed (via signed proposal)	7/27/2015	Village of Grafton	Mr. Timothy Nennig Utility Superintendent
Purchase Order No. W15-028	7/21/2015	Village of Grafton	Mr. Timothy Nennig Utility Superintendent

Project Description

PSI understands that the project consists of the reconstruction of a portion of River Bend Road and a portion of 17th Avenue; the installation of a new interceptor sewer, force main, and future sewer; the construction of a lift station; and the replacement of a culvert in the Village of Grafton, Wisconsin. No plans were provided for review in preparation of this report.

The roadway reconstruction is anticipated to consist of two sections. The northern section consists of 17th Avenue from about Falls Road at the north end to Manchester Drive at the south end. This section is understood to be considered for complete reconstruction, including the removal of both the existing asphalt and aggregate base. New utilities in this area are to be constructed by open cut methods. The eastern section of the reconstruction consists of River Bend Road from about Manchester Drive at the west end to about 500 feet east of Yuma Street at the east end. This eastern section is understood to be considered for pulverization of the existing asphalt and aggregate base, and overlay with a new asphalt pavement. Widening of the roadway to the north may also occur in this eastern portion. Utility installation in this area is proposed to be performed by horizontal directional drilling.

The project also includes the installation of a new interceptor sewer to the west of Yuma Street; a future sewer line along River Bend Road, to the east of Yuma Street; and a force main along the west end of River Bend Road and to the north along 17th Avenue to Falls Road. The future sewer and interceptor sewer are also likely to be constructed by open cut methods.

A new lift station is proposed on the north side of River Bend Road, about 500 feet west of Yuma Street. The lift station is understood to consist of a dry well and wet well. The wet well portion will be a precast concrete structure with an inside diameter of about 12

feet, and a bearing elevation of EL. 674 feet MSL. The lift station will include an adjacent building of slab-on-grade construction. The building is understood to be heated and will be constructed upon cast-in-place spread footings bearing at an elevation of about EL. 712 feet MSL. The building will include masonry walls with a wood truss roof structure, and will encompass a 30'8" by 24'0" footprint.

The project also includes the replacement of an existing culvert on River Bend Road near the intersection with 17th Avenue. The proposed new culvert is understood to be an elliptical concrete pipe about 68 inches by 106 inches in height and width. The bottom of the culvert is understood to be at about EL. 687 feet MSL. No plans were provided in preparation of this report. The following table lists the material and information provided for this project:

DESCRIPTION OF MATERIAL	PROVIDER/SOURCE	DATE
Boring Location Diagram	Applied Technologies	6/17/2015

The geotechnical information presented in this report is based on the available project information, and the subsurface materials described in this report. If the noted information is incorrect, please inform PSI in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client.

Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site and provide general recommendations for reconstruction of the roadway, installation of the new utilities, construction of a lift station and adjacent building, and the replacement of the existing culvert. PSI's scope of services included drilling a total of 8 soil test borings, select laboratory testing, and preparation of this geotechnical report.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The project site includes River Bend Road beginning at a point about 500 feet to the east of Yuma Street and extending west to 17th Avenue; and then proceeding north along 17th Avenue to about Falls Road in the Village of Grafton, Wisconsin. The project site also includes an area north of River Bend Road beginning about 500 feet to the west of Yuma Street, extending northeast about 900 feet. The site is generally within a residential area. The existing 17th Avenue includes one travel lane in each direction, and a parking lane

on each side. Concrete curb and gutter begin on the east side of 17th Avenue just to the north of Manchester Drive and extends north to Falls Road. Curb and gutter on the west side of 17th Avenue begins at about Valley Drive and extends north to Falls Road. River Bend Road includes one travel lane in each direction, without curb and gutter. Ditches are generally present to each side of the roadway in this area. The existing pavement in these areas is generally fair to poor, with extensive transverse and longitudinal cracking, areas of alligator cracking, and areas of wheel rutting. In general, the pavement of River Bend Road is in poorer condition that that of 17th Avenue.

The topography of the project site is hilly in nature, with elevations at the borings varying from approximately EL. 697 feet to EL. 794 feet (MSL).

Subsurface Conditions

The subsurface conditions were explored within 8 soil test borings as requested. The approximate locations are shown on the attached Boring Location Plan. The borings were performed to planned depths of 15 to 45 feet below existing grades as requested. The locations of the borings were field staked by Applied Technologies. The elevations of the borings were also provided by Applied Technologies. Boring B-1 was extended from 35 to 40 feet due to the necessary offset about 30 feet to the east which was about 5 feet higher in elevation than the original location. This offset was necessary due to a steep slope. The borings were advanced utilizing hollow stem auger drilling methods. Soil samples were routinely obtained during the drilling process at 2.5 foot intervals up to a depth of 10 feet, and every 5 feet thereafter. Drilling and sampling techniques were accomplished in general accordance with ASTM procedures.

Representative soil samples were obtained from the soil borings and were returned to PSI's laboratory where they were visually classified using the Unified Soil Classification System (USCS) as a guideline. Further, we conducted limited laboratory testing on select soil samples to aid in identifying and describing the physical characteristics of the soils and to aid in defining the site soil stratigraphy. The results of the field exploration and laboratory tests were used in our engineering analysis and in the formulation of our engineering recommendations.

The borings were generally completed at the locations staked by Applied Technologies. As indicated, B-1 was offset about 30 feet east due to a steep slope. The following table contains the surface elevations of the soil borings, and depth and elevation to which each boring was completed. The elevations were rounded to the nearest foot. Also included is the planned invert or foundation bearing grade as provided by the client.

Boring	Surface Elevation (MSL) (feet)	Location	Boring Completion Depth Below Existing Grade (feet)	Boring Completion Elevation (MSL) (feet)	Invert or Bottom of Foundation Elevation (MSL) (feet)
B-1	708	Lift Station/Building	40	668	674
B-2	703	Interceptor Sewer	25	678	683
B-3	697	Interceptor Sewer	20	677	684

BORING	SURFACE ELEVATION (MSL) (FEET)	LOCATION	BORING COMPLETION DEPTH BELOW EXISTING GRADE (FEET)	BORING COMPLETION ELEVATION (MSL) (FEET)	INVERT OR BOTTOM OF FOUNDATION ELEVATION (MSL) (FEET)
B-4	732	Future Sewer	45	687	692
B-5	697	Force Main/Culvert	15	682	685
B-6	712	Force Main	15	697	706
B-7	761	Force Main	15	746	753
B-8	794	Force Main	15	779	786

The surface materials present at most of the borings consisted of about 3 to 7 inches of topsoil or topsoil fill. As an exception, the surface materials at B-8 consisted of about 4 inches of asphalt overlying about 12 inches of crushed stone aggregate base. Below the surface materials at B-2, B-3, B-7, and B-8, were fill or possible fill soils to depths of about 3 to 5.5 feet below existing grades. About 12 feet of possible fill soils were encountered at B-5. The fill soils generally consisted of lean clay or sandy lean clay with varying sand and gravel content. Strength tests indicated estimated unconfined compressive strengths on the order of about 3.0 tons per square foot, and N-values ranging from about 3 to 18 blows per foot.

Below the fill and possible fill at the above locations, and below the surface materials at the remaining locations were natural soils comprised of brown and reddish brown lean clay or silty clay; brown sandy silt; or light brown, brown, and gray fine to medium sand to the termination depths of the borings. The natural clay soils were stiff to hard in consistency, with estimated unconfined compressive strengths ranging from about 1.0 to 4.5 tons per square foot (tsf). The natural granular soils were loose to very dense in relative density with N-values ranging from about 7 blows per foot to 50 blows for 2 inches of split spoon sampler penetration.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, locations of the samples, and laboratory test data. The stratifications shown on the boring logs represent the conditions at the actual boring locations only. Variations may occur and should be expected between and beyond the boring locations. The stratifications represent the approximate boundaries between subsurface materials and the actual transitions may be gradual. The samples that were not discarded during classification or altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

Groundwater Information

Groundwater was encountered at borings B-2 and B-3 at depths of about 12 and 8 feet (EL. 691 feet and EL. 689 feet), respectively, during drilling. No water was encountered at any of the borings, above the caved soils, upon completion of drilling. However, due to the presence of clay soils at this site, which exhibit relatively low permeability

characteristics, longer observation times (not included in PSI's project work scope) are typically required in order to accurately determine the subsurface long term water level for these soil types. Fluctuations in the groundwater level should be anticipated throughout the year depending on variations in climatological conditions and other factors not apparent at the time the borings were performed. The possibility of groundwater level fluctuation should be considered when developing the design and construction plans for the project. PSI recommends that the contractor determine the actual groundwater levels at the site at the time of the construction activities.

EVALUATION AND RECOMMENDATIONS

Geotechnical Discussion

There are three primary geotechnical related concerns at this site, which will mainly affect earthwork operations for this project. The following summarizes these concerns:

1. ***Construction of the lift station and installation of utilities will result in groundwater and excavation stability issues, at least in some areas. Proper dewatering and shoring/bracing of the excavation sidewalls must be performed as necessary.***

In general, open cut utility installation will require excavation into granular soils, and in some cases will require excavation below the groundwater. Invert elevations for the proposed interceptor sewer and future sewer are up to about 20 and 40 feet below existing grades, respectively. Excavations will require proper sloping, shoring, and bracing, as necessary. Where excavations extend several inches into the groundwater, it is expected that filtered sump pumps or other conventional means should suffice to control the groundwater. However, where excavations extend to significant depths below the groundwater, or for substantial perched zones, prolonged dewatering with a series of sumps or well points and high capacity sump pumps, or other more comprehensive means, will likely be necessary to facilitate construction.

In the areas of the wet well (boring B-1) and the future sewer (B-4), sloped or benched excavations will likely not be feasible based upon the depth of the excavations below existing grades (34± feet and 40± feet, respectively). In these areas, proper shoring or bracing will be necessary. Caving and sidewall instability in open cut excavations will be experienced with increasing depth, especially where granular soils are encountered and where excavations encroach upon or extend below the groundwater. Although no free water was encountered within the area of the B-1, which was performed in the area of the proposed lift station, very moist soils were encountered at a depth of about 32 feet (EL. 676 feet). Sheet piling cutoff walls, or cofferdam construction, along with suitable dewatering measures may be necessary to help control groundwater and retain excavation sidewalls in the wet well area. Cofferdam (or other bracing and retaining structures) design must be performed by an experienced structural engineer.

Based upon borings B-2 and B-3, excavations for the proposed interceptor sewer will

extend about 8 and 5 feet below the groundwater and into fine sand soils. These conditions will cause severe excavation instability issues and will require proper shoring and bracing, and a dewatering system consisting of a series of sumps or well points and high capacity pumps or other more comprehensive means to allow for proper utility installation and backfilling.

2. ***The existing soils encountered below the topsoil are generally considered to be suitable for support of the planned new pavement and utilities placed upon them. However, zones of soft or otherwise unsuitable soils requiring remediation may be encountered in areas within the fine grained cohesive soils.***

Although encountered in a relatively moist condition during the exploration, the on-site lean clay soils may be very moist to wet at the time of construction depending upon rainfall, thaw, or snow melt. Clayey soils are considered highly moisture sensitive and subject to softening. Therefore, equipment and worker traffic must be kept to a minimum on subgrade bearing surfaces, especially during times of precipitation or following spring thaw. Some difficulty with subgrade preparation can be expected in wet or cold weather conditions. Remediation in the form of scarifying/drying/recompacting, or removal and replacement, will be necessary in areas which become unstable.

The on-site cohesive soils are also generally considered to be suitable for support of utilities. However, soft, wet, or otherwise unsuitable bearing soils may be encountered on an isolated basis, or may develop where trenches are left open and the subgrade is allowed to become disturbed. In this case, over-excavation of the unsuitable soils, and replacement with a crushed stone will be necessary.

3. ***Existing fill and possible fill soils were encountered in the proposed culvert area, within boring B-5, to a depth of approximately 12 feet (EL. 685 feet) below existing ground surface. It should be anticipated that the depth and consistency of the existing fill materials may change throughout the proposed culvert area, beyond the boring performed.***

Existing fill soils are not considered suitable for support of the proposed culvert due to their potential for excessive overall and/or differential settlement, and resulting distress to the overlying structure. The underlying natural soils exhibited moderate strength characteristics, and are considered suitable for support. **As such, PSI does not recommend that culvert bear upon existing undocumented fill soils. Within the culvert subgrade excavation, full removal of any existing fill to expose underlying suitable natural soils, is therefore recommended.** Difficulty with excavation stability may be experienced. Proper shoring, benching, or bracing must be performed as necessary to maintain stability.

The following geotechnical related recommendations have been developed on the basis of the subsurface conditions encountered and PSI's understanding of the proposed development. Should changes in the project criteria occur, a review must be made by PSI to determine if modifications to our recommendations will be required.

Lift Station Subgrade Preparation

The presence of organic topsoil and vegetation in the subgrade can adversely affect the serviceability of structural fills, foundations, floor slabs, pavements, and other structures placed upon them. Approximately 6 inches of topsoil was present on the surface of the site at boring B-1. However, some variation should be anticipated. All topsoil, vegetation, roots, and other organic matter must be stripped from the areas of footings, floor slabs, and other structures.

The exposed subgrade soils in the lift station area are generally expected to consist of natural sandy silt soils. Such soils are considered highly moisture sensitive and subject to softening. Therefore, equipment and worker traffic must be kept to a minimum on subgrade bearing surfaces, especially during times of precipitation or following spring thaw. Some difficulty with subgrade preparation can be expected in wet or cold weather conditions. Substantial construction delays and difficulty with subgrade stabilization should be expected during periods of wet and/or cool weather.

After stripping the topsoil and cutting high areas of the site to the planned finished grade, and prior to the placement of new fill which may be placed to raise grades, the subgrade in structural areas must be thoroughly proofrolled to detect unstable, yielding soils, which must be removed or improved by appropriate preparation and compaction techniques. Proofrolling should consist of overlapping passes in a perpendicular grid pattern of a fully-loaded tandem-axle dump truck, or other equipment of similar size and weight. However, care must be used on this site to avoid disturbing the near surface fine-grained soils during proofrolling, especially during periods of precipitation or spring thaw. Proofrolling with rubber tired equipment may be preferable, but should be performed in consultation with the geotechnical engineer at the time of construction. Unstable soils should be expected, at least on an isolated basis. When encountered, they must be improved in place (if possible) or removed and replaced. Scarification, drying, and recompaction of wet soils, or removal and replacement with suitable fill, are two methods which can be considered, but this must be determined by the soils engineer at the time of construction. It must be recognized that the clay soils present on the site are highly moisture sensitive, and substantial difficulty with subgrade preparation can be expected if these soils are wet during construction.

When a firm and stable subgrade is established, low areas may be raised to planned grades with properly compacted structural fill. If fine-grained soils, such as those with high silt or clay content are used, they should generally be placed over large open areas, where conditions are more favorable for the proper placement and compaction of such materials. It must be recognized that high silt or clay content materials are difficult to compact when placed at moisture contents beyond a few percent of the optimum moisture content. The on-site soils beneath the topsoil are considered suitable for use as new fill to raise grades, generally over large areas. However, some sorting or moisture conditioning may be required. Silt, clay, and wet granular soils are not suitable for reuse as compacted fill in trenches, or adjacent to foundation stem walls or retaining walls.

Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. This is especially true of clayey soils, where scarification and aeration may be required to achieve near optimum moisture levels prior to compaction. In addition, the near surface soils across the site are considered moisture sensitive; therefore, some difficulty with subgrade preparation should be expected, especially if they become wet during construction. Fill must be placed in layers of not more than eight (8) inches in thickness, at moisture contents at or near optimum, and be compacted to a minimum density of 95 percent of the maximum dry density as determined by the Modified Proctor (ASTM D1557).

It is anticipated that the wet well portion of the pump station will be excavated with a backhoe by benching, and utilizing sloping and bracing. Installation of sheet piling or other bracing and excavation retention methods may also be necessary. As a result, surface structures adjacent to the well portion of the structure may bear upon compacted structural backfill from the wet well excavation. It is recommended that well-graded granular soils be utilized as backfill in new utility trenches and alongside the wet well below grade walls to reduce the potential for consolidation and settlement of the fill. All fill soils must be placed and compacted under engineering controlled conditions, to provide suitable support for overlaying structures and pavements. Additional guidance can be provided at the time of construction in the selection process for grade-raising fill and trench backfill.

When excavations encroach upon or extend below the groundwater or perched zones, and into sandy or silty soils, subgrade instability and sloughing/caving of sidewalls can occur. Some over-excavation of softened or loosened soils, in conjunction with the use of a crushed stone working mat, may be necessary. Additionally, significantly widened excavations may result, or be required for stability.

Every effort must be made to keep excavations dry. If construction proceeds during wet weather, some additional over-excavation may be necessary. If weather permits, the soil could be dried and recompacted. A crushed stone working mat, possibly in conjunction with a geotextile fabric may also be feasible to help stabilize subgrades. Site grading runoff should be directed to catch basins, so that the potential for the softening of the foundation and pavement subgrade soils is reduced.

The selection of fill materials for various applications should be done in consultation with the soils engineer. Similarly, the evaluation of the subgrade and placement and compaction of fill for structural applications should be monitored and tested by a qualified representative of the soils engineer.

The following geotechnical related recommendations have been developed on the basis of the subsurface conditions encountered and PSI's understanding of the proposed project. The soil test borings are widely spaced and the soil profile between the borings has been estimated by interpolation. Anomalies and unanticipated conditions may require the field determination of construction procedures. Should changes in the project criteria occur, a review must be made by PSI to determine if modification to our recommendations will be required.

Pavement Subgrade Preparation

It is understood that in the area of River Bend Road, reconstruction is to consist of recycling the existing asphalt pavement and underlying base in place into a new pavement base course. This method generally requires pulverizing the existing HMA and aggregate base into a new aggregate base, regrading, and recompacting the base materials, and then placing a new HMA pavement surface. Due to the pulverization and inherent low moisture content of the existing asphalt, the recycled base material must be moisture conditioned to within about a few percent of optimum. This will likely require the addition of water. The recycled base should then be compacted with a large vibratory studded drum roller to a density of at least 95 percent of the maximum dry density as determined by the Modified (ASTM D1557) Proctor method. Additional preparation of the recycled base may be required if underlying wet or soft subgrade conditions are encountered in the existing subgrade. Removal of the recycled base may be necessary in areas for remediation of the underlying subgrade, if instability is encountered. Additional widened areas must be stripped of surface topsoil to expose suitable underlying natural soils. When this method is employed and the subgrade and pulverized base is prepared as outlined in this report, a soil support valve of 4 for the existing clayey subgrade and a structural coefficient (a) ranging from about 0.1 to 0.25 (dependent upon the type and percentage of base materials incorporated into the pulverized mix) for the pulverized RAP base material are suggested for pavement section design. This range of structural coefficients is described in the WisDOT Facilities Development Manual.

If recycling of the HMA layer and existing aggregate base is performed, it could also be treated with class C flyash, Portland cement or an asphalt emulsion to provide a stabilized RAP base layer. A properly treated/stabilized base layer will generally produce a higher strength base layer which results in a reduction in the potential of the stabilized base to deform under repeated loads and provides better support over the poorer subgrade soil conditions. A properly stabilized RAP base can also provide a higher structural coefficient for the base which may lead to a thinner pavement section. However, the stabilization potential of the existing pavement materials must be evaluated by PSI with a proper laboratory mixture evaluation to determine the optimum treatment content and degree of base improvement. When properly stabilized, the stabilized RAP base can provide a structural coefficient (a) on the order of 0.25 based on Procedure 14-25-20 of the FDM.

The reconstruction in the area of 17th Avenue is understood to include complete removal of the existing pavement section and replacement with a new section. For the planned total reconstruction, the removal of the existing pavement section should be performed in accordance with the methods and procedures outlined in Section 204 of the WisDOT Standard Specifications. Additionally, all vegetation and topsoil must be removed in any new pavement areas outside of the limits of the existing pavement areas.

Prior to placement of the pavement materials, the exposed subgrade or pulverized asphalt layer should be proofrolled with a fully loaded tandem axle dump truck. Only minor movement and rutting should be observed (typically less than about 1 inch) on

the exposed subgrade, with no appreciable movement or rutting on the recycled asphalt layer. At least some unstable areas are likely to be present. The near surface lean clay soils encountered in some of the borings were in a very moist or wet condition during the exploration, and other areas may be very moist to wet during construction, depending upon recent rain events, thaw, snow melt, etc. The higher moisture contents may cause the clay soils to be unstable during construction, especially when subjected to construction traffic. If observed to be unstable during construction, these soils may either be scarified, dried, and recompacted to a minimum of 95 percent of the maximum dry density as obtained by the Modified Proctor test (ASTM D1557), or undercut and replaced with select granular soils such as those identified in WisDOT Standard Specifications Sections 209 or 305. If unstable subgrade conditions are encountered or develop under recycled base areas, removal of the base material will need to be performed to improve the subgrade condition. Subgrade preparation during dry periods will help facilitate this process.

Care should be taken to fully proofroll around all manholes. It is very common that manhole backfill is extremely loose. If extremely loose backfill is observed around the manholes, PSI recommends that the very loose backfill be removed in its entirety and backfilled properly with a well graded granular soil. If a clear stone is used to backfill the manhole, a non-woven geotextile fabric should be placed between the wall of the excavation and the backfill. The clear stone should be vibratory compacted in lifts to lessen the effects of backfill settlement. Reflective settlement around manholes will likely be observed within the first or second year of pavement life if loose backfill materials are left in place.

Where these unstable areas cannot be improved in-place, any areas of pulverized asphalt pavement materials must be removed and the existing unstable subgrade soils must be undercut to exposed suitable stable underlying soils. Undercut depths are estimated to be on the order of 12 to 18 inches to achieve stability; however, this must be determined based upon field observations at the time of construction. The lateral extent of over-excavations must be equal to the depth of the undercut below the planned bottom of base course. Greater over-excavation depths may be necessary at least in areas to expose suitable stable soils. The over-excavated area must then be backfilled in 8 inch loose lifts with 3 inch dense graded base generally meeting Sections 209 or 305 of the Wisconsin Standard Specifications for Highway and Structure Construction, possibly in conjunction with a geogrid (where necessary), to stabilize the existing subgrade soils. The stone should be end-dumped and pushed onto the subgrade with dozers or other equipment which has lighter contact pressure so that the trucks delivering it are not allowed to drive directly on top of the exposed subgrade soils. The undercutting and backfilling activities should be observed by a representative of the geotechnical engineer. Compaction of backfill materials should be performed according to WisDOT “Special Compaction”.

Where complete reconstruction of the pavement is proposed, and unstable areas of clay are encountered, as an alternative to the above recommendations, the wet clay soils can be dried/stabilized using chemical methods such as lime kiln dust or lime. Prior to using a chemical additive, the soil should be tested for sulphate, pH, resistivity and chloride in order to verify that heave will not occur due to use of a chemical. Other

materials such as fly ash and cement slag have been used in this market but have also been associated with severe heave of the subgrade soils. Therefore, if these chemicals are being considered, a full bench study and swell test should be completed along with a heavy scrutiny of the source of the materials.

The clay subgrade soils should be crowned at the centerline to slope towards the ditches at either side to promote positive base drainage. After an acceptable subgrade condition is achieved, the placement and compaction of the pavement section or any base course or new fills may begin, as appropriate. The placement and compaction of all base course and fill soils should be monitored by a representative of the geotechnical engineer. Fill and base course placement should be done in accordance with the State of Wisconsin's Standard Specifications for Highway and Structure Construction. PSI recommends that fill and base course be compacted as per the State's Standard Specifications for "Special Compaction" (Section 207.3.6.3 for fill and Section 301.3.4.3 for base course).

Foundation Recommendations

Lift Station

The proposed lift station may be supported by conventional spread and/or mat foundation systems, bearing on suitable naturally occurring soils or properly placed and compacted structural fill/backfill. Based on the boring performed near the proposed lift station (B-1) medium dense natural sand is anticipated to be present at the planned wet well bearing elevation of EL. 674 feet. Proper placement and compaction of backfill alongside the wet well will be essential for proper support of any shallower structures, such as the adjacent dry well or associated building. **A mat or spread foundation used to support the lift station wet and dry wells, bearing upon suitable natural medium dense sand soils or properly placed and compacted structural fill/backfill, may be designed for a net allowable soil bearing pressure of 4,000 psf.**

Lift Station Building

The lift station building foundation, with a planned bearing elevation of EL. 712 feet, is estimated to be supported by at least several feet of newly placed structural fill, or backfill from the wet and dry well excavation. Proper placement and compaction of these fill/backfill materials, as specified in the above Site Preparation section, must be performed. **A mat or spread foundation used to support the lift station building bearing upon properly placed and compacted structural fill/backfill may be designed for a net allowable soil bearing pressure of 4,000 psf.**

Culvert

The proposed culvert may be supported by a conventional spread foundation system, or can be supported without a foundation where it bears upon suitable naturally occurring soils or properly placed and compacted structural fill/backfill. Based on the boring performed near the culvert (B-5), lean clay possible fill soils are anticipated to be

present at the planned bearing elevation of EL. 687 feet and extend to an elevation of about EL. 685 feet. Existing fill soils are not considered suitable for support of the culvert. Where present below planned bearing grade, existing fill soils must be removed to expose suitable underlying natural soils. Undercuts on the order of about two (2) feet are anticipated. However, some variation in undercut depth must be expected. **A spread foundation used to support the culvert, or a culvert placed without a foundation, upon suitable properly placed and compacted structural backfill may be designed for a net allowable soil bearing pressure of 2,000 psf.** Some over-excavation of low strength natural soils may be necessary to achieve the bearing capacity specified.

General Foundation Recommendations

The suitability of the existing soils for support of the proposed lift station/building and culvert foundations must be determined by testing by a qualified geotechnical engineer during construction, utilizing static cone penetrometer tests or dynamic cone penetrometer tests for cohesive and granular soils, respectively. Soft, loose, or otherwise unsuitable materials not disclosed by the borings, may be encountered in the foundation excavations at the bearing elevations, and must be properly remediated.

Natural sand materials or structural fill materials are anticipated to be present at bearing grades or at the depth of recommended over-excavations. Sand soils are susceptible to some loss in strength when the confining effect of the overburden is removed, especially in the presence of water or where these soils are in a very moist condition. A somewhat loosened subgrade may develop, requiring limited undercutting and the use of a crushed stone working mat to establish a stable bearing grade. Substantial sloughing and caving may also occur. Dewatering may be required.

All footings must be placed at a depth of 4 feet below the finish grade for frost protection where the structure is not heated. Interior footings in heated areas, such as the lift station building, not subject to frost action may be placed at a shallow depth of 18 inches below the floor slab, provided they bear on suitable natural soils or engineered fills. All footings must be protected from the effects of frost if construction is carried out during winter months.

It is recommended that the footings supporting individual columns have a minimum dimension of 30 inches, and continuous footings have a minimum width of 18 inches, even if the maximum recommended allowable bearing pressure is not fully utilized. In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils and any variations in seasonal moisture contents, it is recommended that all continuous footings be suitably reinforced to make them as rigid as needed.

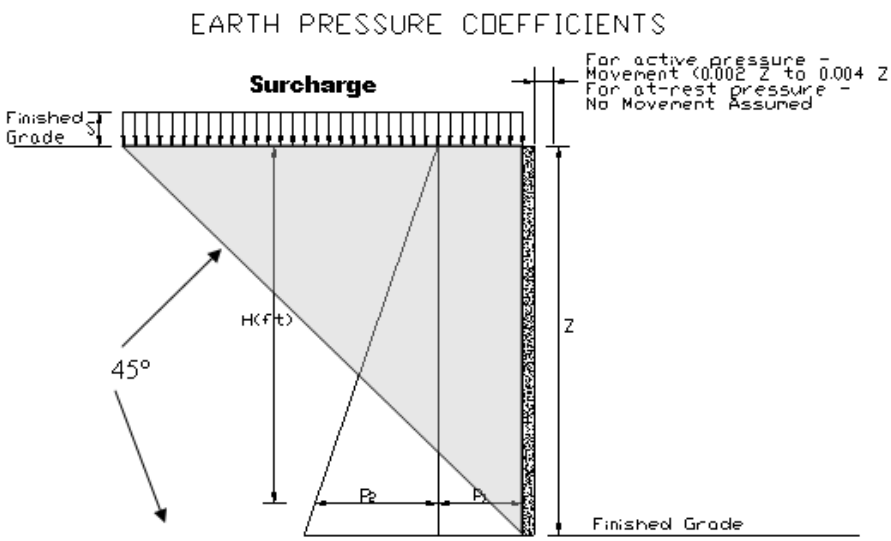
The below grade walls of the lift station and culvert must be backfilled with a well graded granular soil. Silt and clay soils, wet granular materials, and organic soils are not suitable for use as backfill. The wall backfill must be placed in lifts not exceeding 8 inches in thickness and compacted to 95 percent of the maximum dry density as determined by the Modified Proctor method (ASTM D1557). Proper placement and

compaction of the backfill will be essential for the development of proper support of overlaying footings, pavements, utilities, and structures. The selection of backfill material should be made in consultation with the geotechnical engineer.

In general, the performance of the foundation systems on this site is dependent on the various factors discussed herein. The excavation, preparation, and concreting of foundations should be monitored and tested by a representative of the soils engineer.

Below Grade Walls and Drainage

Walls with unbalanced backfill levels on opposite sides (such as lift station and culvert walls) must be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction, and the strength of the materials being restrained. Lateral earth pressure is developed from the soils present within a wedge shaped geometry formed by the vertical below-grade wall and an imaginary line extending up and away from the bottom of the wall at an approximate 45° angle (see diagram). The lateral earth pressures are determined by multiplying the vertical applied pressure by the appropriate lateral earth pressure coefficient K. If the walls are rigidly attached to the structure and not free to rotate or deflect at the top, PSI recommends designing the walls for the at-rest lateral earth pressure condition using K_o. Walls that are permitted to rotate and deflect at the top can be designed for the active lateral earth pressure condition using K_a. Passive pressure can be determined using K_p, with a factor of safety of 2.0. Recommended parameters for use in below grade walls are as follows based on the use of a select crushed limestone material:



Parameters specific to soil type	Imported Crushed Limestone (ϕ=35, γ=135 pcf)
Coefficient of Active Pressure (K_a) **	0.27 *
Coefficient of At-Rest Pressure (K_o) **	0.43 *
Coefficient of Passive Pressure (K_p) **	3.70 *

Parameters specific to soil type	Imported Crushed Limestone (ϕ=35, ɣ=135 pcf)
Undrained Fluid Pressure for Active Case	82 pcf
Undrained Fluid Pressure for At-Rest Case	94 pcf
Undrained Fluid Pressure for Passive Case	330 pcf
Drained Fluid Pressure for Active Case	36 pcf
Drained Fluid Pressure for At-Rest Case	58 pcf
Drained Fluid Pressure for Passive Case	500 pcf

* These values may be used for design only if the imported crushed limestone extends a lateral distance from the back of the wall approximately equal to or greater than half the total height of the wall at the surface or six feet, whichever is less.

** Earth pressure coefficients valid for level backfill conditions with no surcharge.

Conditions applicable to the above conditions include:

- For active earth pressure, wall must rotate about base, with top lateral movements 0.002Z to 0.004Z, where Z is the wall height
- For passive earth pressure, wall must move horizontally to mobilize resistance
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 135 pcf for granular soils
- Horizontal backfill, compacted to at least 95% of Modified Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No safety factor included
- Ignore passive pressure in frost depth zone

Backfill placed against lift station and culvert walls should consist of free draining (less than 5 percent fines) granular soils. For granular values to be valid, the granular backfill must extend out laterally from the walls a distance equal to half the wall height or 6 feet, whichever is less. To calculate the resistance to sliding, a value of 0.35 should be used as the allowable coefficient of friction between the footing and the underlying soils.

If the installation of a perimeter drain behind the walls extending to the foundation level is not possible due to the groundwater level relative to the foundation level, then drained and undrained parameters, as indicated above, must be assigned appropriately. These pressures are ultimate values and do not include the influence of surcharge or slope at the top of the wall, which must be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

PSI recommends that a perforated drain line be installed behind the walls, at an elevation above the groundwater, to relieve hydrostatic loading on the walls. The drain line should have positive drainage to a collecting point. To reduce the intrusions of fines, the drain should be surrounded by clean, well graded, granular material wrapped in a non-woven geotextile filter fabric. The free draining granular fill should be used to backfill the wall to within 2 feet of final grade. The remaining upper portion of the excavation should be backfilled with cohesive soils to reduce infiltration of surface water into the drain system. A procedure should be used to discharge water from the collecting point, which would not

allow reverse flow into the system.

Hydrostatic Uplift Resistance Considerations

The proposed well structure may experience the effects of hydrostatic uplift. The uplift force can be resisted by the dead weight of the structure and the weight of the soil above the horizontal projection of the footing. A moist unit weight of 135 pounds per cubic foot, and a buoyant unit weight of soil of 72 pounds per cubic foot may be used, above and below the groundwater, respectively, when calculating the weight available to resist uplift force, based upon the use of well-graded granular backfill. The soil mass may be estimated by a line extending from the base of the footing to the surface, rotated outward from the footing, 30° from vertical. All soil within the "wedge" shaped geometry may be used to resist uplift. The effect of hydrostatic uplift may also be reduced with the incorporation of a properly designed drainage system, placed around and beneath the structure, or with other suitably designed anchoring systems.

Floor Slab Recommendations

Based on the subgrade soils being properly prepared, PSI recommends that a subgrade modulus (k) of 150 pounds per cubic inch (pci) be used for the floor slab design considerations for the wet and dry wells and the lift station building based on a 12 inch diameter plate load test. However, depending on how the slab load is applied, the value will have to be geometrically modified. The value should be adjusted for larger areas using the following expression for cohesive and cohesionless soil:

Modulus of Subgrade Reaction, $k_s = (\frac{k}{B})$ for cohesive soil and

$k_s = k\,(\frac{B+1}{2B})^2$ for cohesionless soil

where: k_s= coefficient of vertical subgrade reaction for loaded area,
k= coefficient of vertical subgrade reaction for 113 square inches area
B= width of area loaded, in feet

PSI recommends that a minimum four-inch thick free draining granular mat be placed beneath the floor slabs to enhance drainage. The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage.

The floor slabs must be suitably reinforced to make them as rigid as necessary, and proper joints provided at the junction of the slab and the foundation system so that a small amount of independent movement can occur without causing damage. It is recommended that appropriate construction methods and curing procedures be used to minimize shrinkage and curling of the floor slabs.

Pavement Recommendations

The subgrade soils in the area of the roadway reconstruction are anticipated to consist of natural or existing fill materials generally comprised of lean clay. The following

subgrade parameters are based upon the predominance of clay, and are recommended for construction design considerations:

AASHTO Soil Classification	Material	SSV	DGI	Subgrade Reaction Modulus, k (pci)	Resilient Modulus, M_R (psi)	CBR	Frost Index
A-6	II-Poorly Sorted	4.0	14	125	2,800	3	F-4

Note: The above parameters were estimated based upon the soil classification and boring information and were not measured in the laboratory. Based upon the backfill used to replace the EBS areas as meeting 209.2.1 of the Wisconsin Standard Specifications for Highway and Structure Construction. Based on the existing subgrade passing proofroll. If the subgrade does not pass proofroll, EBS or other form of remediation must be performed.

Engineered fill added to raise grades must have design values at least equal to or greater than listed above. The CBR value given above has been estimated. For a less conservative CBR value, PSI recommends that actual CBR tests be performed on each type of material, including the proposed base course material. Preparation of the existing ground surface and construction of the new subgrade and pavements should be in accordance with the Wisconsin Department of Transportation Standard Specifications (Standard Specifications).

Asphaltic binder and surface courses should meet the requirements from Section 460 of the Standard Specifications. Asphaltic courses should be placed and compacted to the minimum required density contained within the above mention section. An adequate number of in-place density tests should be performed during construction to document the placement compaction.

Pavements should be sloped to provide positive surface drainage. Water should not be allowed to pond on or adjacent to the pavement as this could saturate the subgrade and cause premature pavement deterioration. The granular base course should be protected from water inflow along drainage paths. Additionally, the granular base course should extend at least one foot beyond the edges of the pavement where possible to allow water that enters the base stone a path for exit.

PSI recommends that subsurface drains be installed. If placed properly, subsurface drains will greatly reduce the amount of trapped water under the pavement surfaces. Trapped water leads to subgrade degradation and increases pavement heave during winter months. It is recommended that underdrains be placed within the subgrade, just below the granular base. Minimally, these drains should be placed in low spots in the pavements, at the toe of slopes that are draining toward pavement surfaces, undercuts that have been filled with granular fill, and as finger drains. At a minimum, finger drains should consist of installing 3 to 4 drain tiles extending radially outward, 20 feet from each interior catch basin. In addition, drain tiles should extend along curb lines, 20 feet up the slope from curb inlets. The drain tile should be directly connected to the storm sewer manholes or catch basins. The drain tile should consist of 4 inch diameter perforated PVC pipe placed beneath the base layer, extending at least 8 inches into the subgrade. The pipe should be surrounded by 1 inch size clean stone, with the pipe and

stone being wrapped with a geotextile filter fabric to reduce the potential of soils from migrating into and obstructing the pipe. The drain tile should be installed with a positive slope (minimum 0.5 to 1 percent) throughout the length of the tile.

CONSTRUCTION CONSIDERATIONS

Open Trench Excavation and Backfilling Recommendations

Based on the information provided to PSI, the new force main in the area of 17th Avenue will be installed using open cut methods. It is also likely that the proposed interceptor sewer and future sewer will also be installed utilizing open cut methods. The planned invert elevations for the force main will extend to depths of approximately 6 to 8 feet below the proposed roadway surface. Excavation depths of about 10 to 14 and 40 feet below existing grades may be necessary for the interceptor and future sewer, respectively. The soils observed at these approximate bearing elevations appear to generally be suitable for support of the proposed utilities. However, some over-excavation of soft, loose, or otherwise unsuitable soils may be necessary, in conjunction with the placement of crushed stone or other suitable granular backfill may be necessary (especially within existing fill zones) to establish a stable working mat and/or bearing subgrade.

Some difficulty with the stability of these open cut utility trenches should be expected due to the presence of upper fill soils and the presence of predominantly granular soils below the shallow cohesive soils, especially in the presence of water. The use of proper shoring, bracing, or trench boxes will be required. Depending upon the depth of the excavations, a sloped or benched excavation may not be feasible. The extent of bracing open cut excavations will depend upon depth of cut, soils encountered, length of time the excavations remain open, area available for excavation, and local governing regulations. Predominantly cohesive soils may appear to stand nearly vertical in shallow excavations for short periods of time. However, soil creep, surcharge loads, precipitation, construction activity, vibrations, and other factors may cause these soils to cave within an unpredictable period of time.

Free groundwater was encountered within borings B-2 and B-3 at depths of about 12 and 8 feet (EL. 691 feet and EL. 689 feet), respectively. In addition, infiltration of perched water into the utility excavations is possible. If minor groundwater seepage is encountered, a typical sump and pump technique should be sufficient for groundwater control. However, where excavations extend below the groundwater, such as near B-2 and B-3, dewatering with a series of sumps and high capacity pumps, or other more comprehensive means will likely be necessary.

Where wet, loose or soft soil conditions are encountered, it may be necessary to place a layer of granular bedding material in the bottom of the excavation to develop a stable working surface. The granular bedding material should meet section 8.43.2 of the Standard Specifications for Sewer and Water Construction, Sixth Edition (SSSWC). A 12-inch layer of cover material should be used to develop the working surface. The cover

material should meet section 8.43.3 of the SSSWC. Trench backfill should be placed in maximum lifts of 8 inches. Smaller lifts may be required if the minimum specified compacted density is not being obtained. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. The bedding and cover materials should be compacted to a minimum in-place density of 95 percent of the maximum dry density and within about 2 percent of the optimum moisture content as obtained by the Modified Proctor test (ASTM D1557). Backfill for utility trenches is as important as the original subgrade preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill of this project.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. It is mandated that excavations, whether they be for utility trenches or footing excavations, be constructed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines to protect workers and others during construction. PSI recommends that these regulations be strictly enforced; otherwise, workers could be in danger and the owner(s) and the contractor(s) could be liable for substantial penalties.

PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

Horizontal Directional Drilling Recommendations

Utilities in the area of River Bend Road are proposed to be installed by horizontal directional drilling methods. Based upon the subsurface conditions observed, the trenchless methods of utility construction should generally be satisfactory for this site. The soils encountered are anticipated to consist predominantly of natural stiff to hard lean clay at shallower depths, with underlying loose to medium dense granular soils. These materials are generally not anticipated to present problems with horizontal directional drilling. However, at greater depths, especially in the area of B-1, some of the natural granular soils displayed very dense relative density, and it is possible that areas of cobbles or boulders may be encountered, which may present problems.

In order to preclude caving of the borehole roof, prudent care must be taken below the existing roadways, driveways, sidewalks, etc. to provide for the presence of sufficient soil materials above the crown of the excavation. The general rule of thumb when drilling in un-consolidated material is to provide approximately 1.5 to 3 times the borehole diameter of soil above the crown of the excavation.

Surface features must be monitored by the Contractor for settlement caused by ground

loss and collapse of the soil above and around the pipe due to alterations of the stresses in the soil. Additional surface ground movement may occur due to the collapse of soil into voids resulting from the removal of cobbles or boulders at the face. Ground movement associated with trenchless construction is influenced by the methods of construction and the quality of workmanship as well as the subsurface conditions. If surface settlement exceeds one inch, corrective measures should be undertaken from the ground surface by the Contractor. If the settlement damages any existing surface structures or underground utilities, the use of compaction grouting techniques should be performed as soon as possible to stabilize and restore the damaged structures.

Drainage and Groundwater Concerns

Groundwater was observed at borings B-2 and B-3 during the drilling operations at depths of 12 and 8 feet (EL. 691 feet and EL. 689 feet), respectively. No water was encountered at any of the other borings during or upon completion of drilling. The groundwater level at B-2 and B-3 is judged to be at EL 691 feet and EL. 689 feet, respectively. Where excavations extend only several inches into the groundwater or perched volumes of water, simple means such as pumping from sumps or the use of perimeter trenches to collect and discharge the water away from the work area should generally be sufficient. However, for deeper excavations, such as for the lift station or for deeper utilities such as in the area of B-2 and B-3, where excavations may encroach upon or extend below the groundwater, a series of sumps and high capacity pumps, or other more comprehensive means will likely be necessary. Fluctuations in the groundwater level should be anticipated throughout the year depending on variations in climatological conditions and other factors not apparent at the time the borings were performed. The possibility of groundwater level fluctuation and perched water conditions should be considered when developing the design and construction plans for the project.

GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding section constitutes PSI's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI's experience in working with these conditions.

REPORT LIMITATIONS

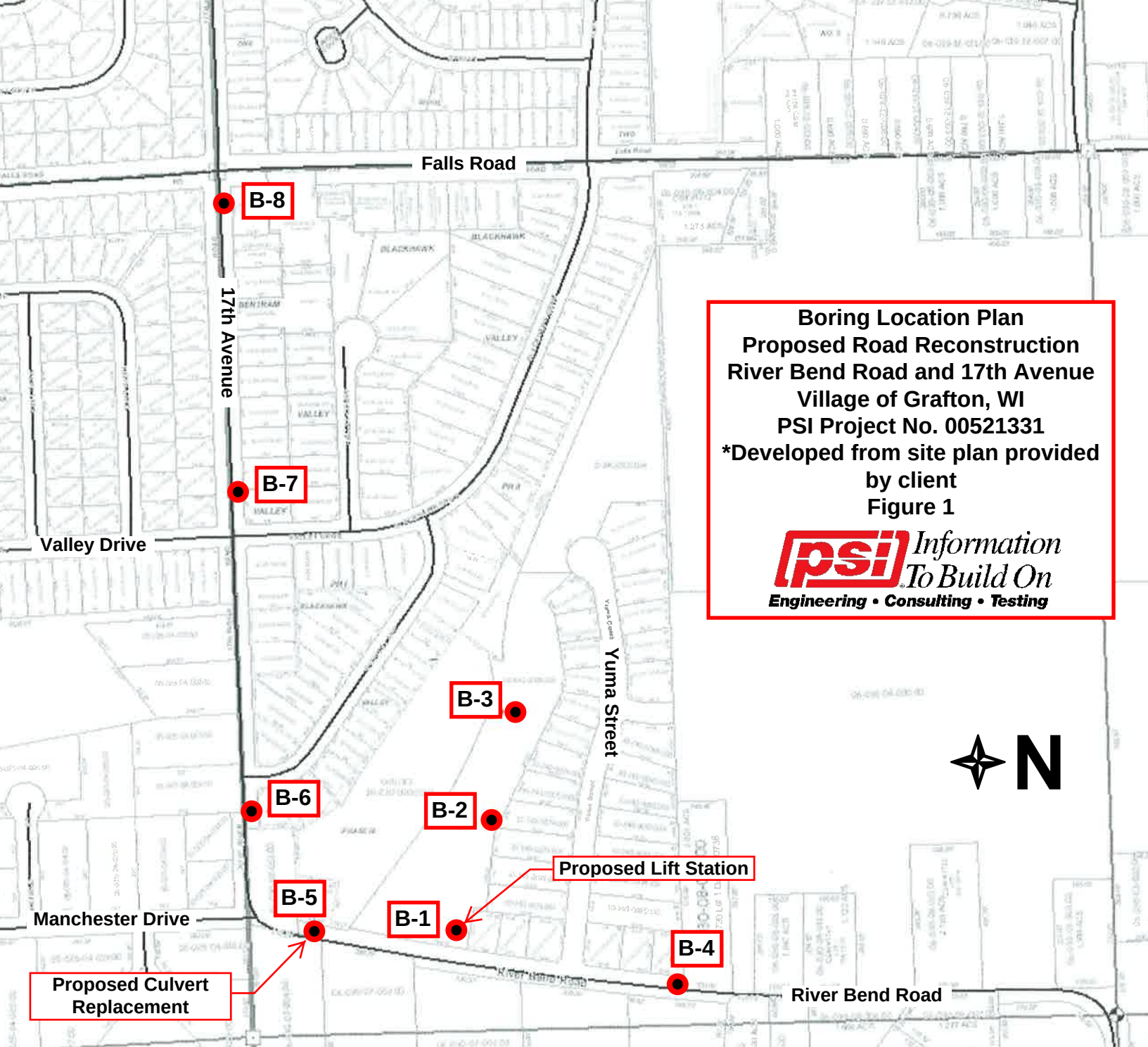
PSI's recommendations are based on the available subsurface information obtained by PSI and design details furnished by others. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI must be notified immediately to determine if changes in the recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

PSI warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, PSI must be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At this time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use by the Village of Grafton for the Reconstruction of River Bend Road project to be located in the Village of Grafton, Wisconsin.

APPENDIX

BORING LOCATION PLAN
LOG OF BORINGS
GENERAL NOTES



Boring Location Plan
Proposed Road Reconstruction
River Bend Road and 17th Avenue
Village of Grafton, WI
PSI Project No. 00521331
***Developed from site plan provided by client**
Figure 1

psi Information To Build On
Engineering • Consulting • Testing

Professional Service Industries, Inc.
821 Corporate Court
Waukesha, WI 53189
Telephone: (262) 521-2125
Fax: (262) 521-2471

LOG OF BORING B-01

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Lift Station Wet Well

WATER LEVELS

While Drilling	Not Obvd.
Upon Completion	Not Obvd.
Delay	N/A

Station: N/A
Offset: N/A

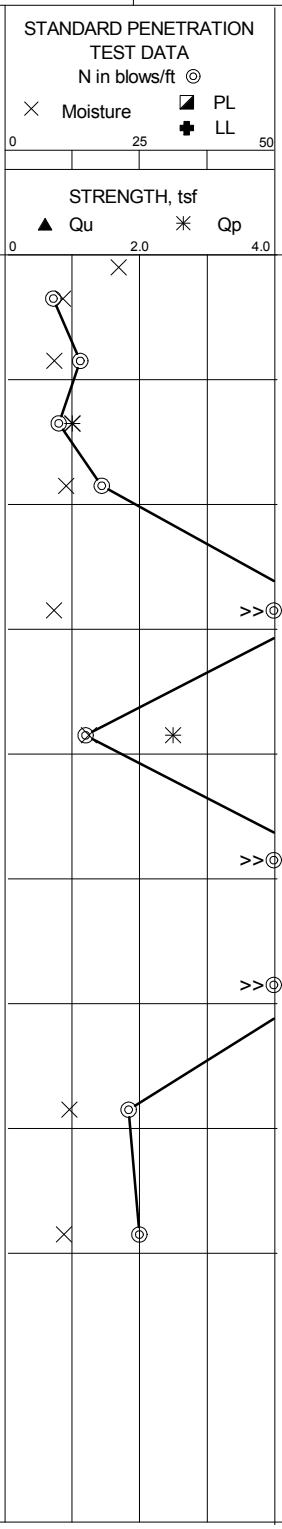
Surface Elev.: 708 ft

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil (6"± Thick)	OL		21	
		1	12	Light Brown Sandy Silt and Gravel, Moist	ML	4-5-4 N=9	11	
705								
	5	2	10	Light Brown Silty Fine Sand and Gravel, Moist	SM	3-4-10 N=14	9	
		3	12	Light Brown Silty Clay, With Sand and Gravel, Moist	CL-ML	3-5-5 N=10	13	
700								
	10	4	10	Light Brown Sandy Silt, With Gravel, Moist		8-11-7 N=18	11	
695					ML			
	15	5	12			N=50/4"	9	>>
690				Light Brown Lean Clay, With Sand and Gravel, Moist				
	20	6	12		CL	20-7-8 N=15	16	
685				Light Brown Sand and Gravel, Possible Cobbles and Boulders, Moist				
	25	7	1			N=50/2"		>>
					SP			
680	30	8	1			N=50/6"		>>
675				Light Brown Fine to Medium Sand, Very Moist				
	35	9	10			6-10-13 N=23	12	
					SP			
670								
	40	10	8			12-11-14 N=25	11	

End of Boring at 40'

Cave In at 27'

Offset 30' east due to steep slope. Due to elevation difference, boring was extended to 40'



Completion Depth: 40.0 ft
Date Boring Started: 9/1/15
Date Boring Completed: 9/1/15
Logged By: PR
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Marooka
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
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LOG OF BORING B-02

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

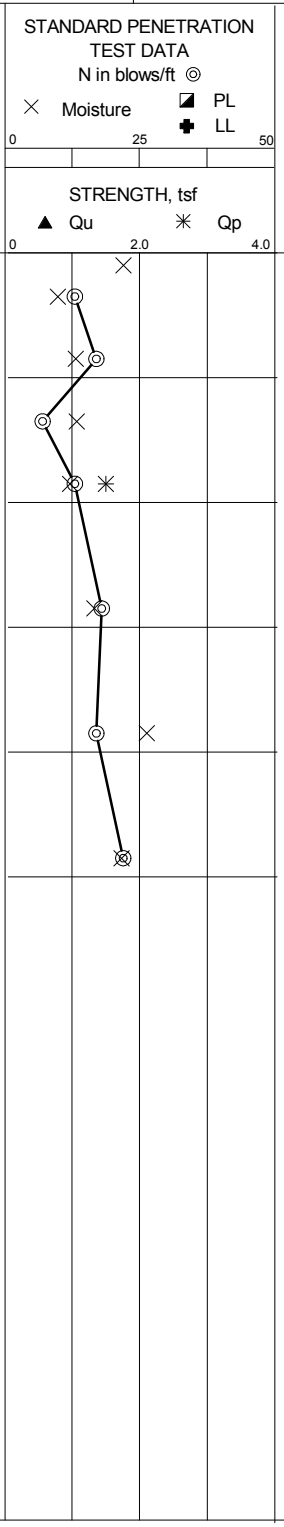
Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Interceptor Sewer

WATER LEVELS
While Drilling 12 feet
Upon Completion Not Obvd.
Delay N/A

Station: N/A
Offset: N/A

Surface Elev.: 703 ft

Elevation (feet)	Depth, (feet)	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0				Topsoil (6"± Thick)	OL		22	
			1	12	Fill, Brown and Reddish Brown Silt and Lean Clay, With Sand, Damp to Moist	FILL	5-6-7 N=13	10	
700			2	4			6-8-9 N=17	13	
	5				Light Brown Silty Clay, With Sand and Gravel, With Silt Seams, Moist				
			3	12			3-3-4 N=7	13	
695			4	6		CL-ML	4-5-8 N=13	12	
	10								
					Brown Fine Sand, With Silty Fine Sand Seams, Trace Gravel, Very Moist to Wet				
690			5	8		SP	4-9-9 N=18	17	
	15								
					Light Brown Fine Sand, Wet				
685			6	12			10-9-8 N=17	26	
	20					SP			
680			7	10			10-11-11 N=22	22	
	25				End of Boring at 25'				
					Cave In at 14'				



Completion Depth: 25.0 ft
Date Boring Started: 9/1/15
Date Boring Completed: 9/1/15
Logged By: PR
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Marooka
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING B-03

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Interceptor Sewer

WATER LEVELS
While Drilling 8 feet
Upon Completion Not Obvd.
Delay N/A

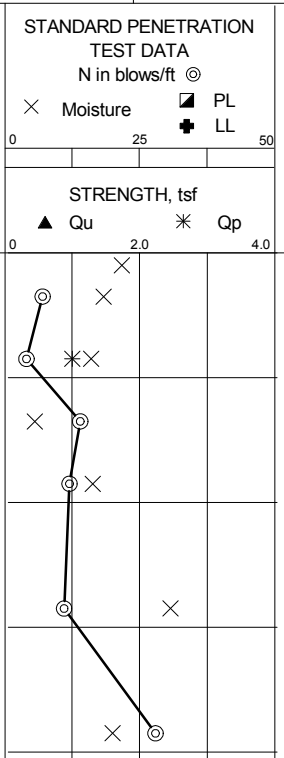
Station: N/A
Offset: N/A

Surface Elev.: 697 ft

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			Topsoil (7"± Thick)	OL		22	
695		1	3	Possible Fill, Brown Sandy Lean Clay, With Gravel, Moist	PFILL	2-3-4 N=7	18	
	5	2	6	Reddish Brown Sandy Lean Clay, With Sand Lenses, Moist	CL	3-2-2 N=4	16	
690		3	12	Light Brown Fine to Medium Sand and Gravel, Moist	SW	5-8-6 N=14	6	
	10	4	4	Brown Medium Sand, Trace to With Gravel, Trace Silt With Silty Sand Seams, Wet	SP	4-4-8 N=12	16	
685				Grayish Brown Fine Sand, Wet				
	15	5	12		SP	5-5-6 N=11	31	
680								
	20	6	18			12-13-15 N=28	20	

End of Boring at 20'

Cave In at 8'



Completion Depth: 20.0 ft
Date Boring Started: 9/1/15
Date Boring Completed: 9/1/15
Logged By: PR
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Marooka
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING B-04

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Future Sewer - River Bend Rd

WATER LEVELS

While Drilling	Not Obvd.
Upon Completion	Not Obvd.
Delay	N/A

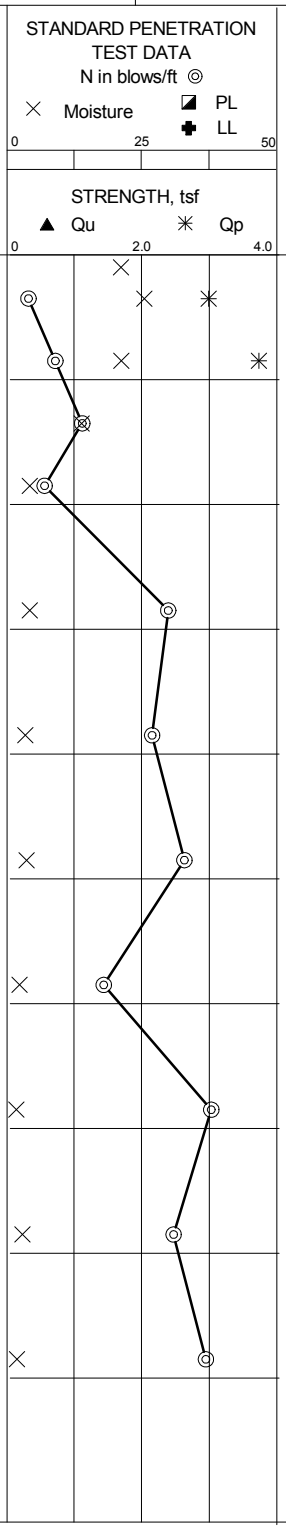
Station: N/A
Offset: N/A

Surface Elev.: 732 ft

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil (6"± Thick)	OL		21	
730				1	6	Reddish Brown Lean Clay, Trace Sand and Gravel, With Silt Lenses, Moist	CL	3-2-2 N=4	26	
	5			2	10			3-4-5 N=9	21	
725				3	12	Brown Sandy Silt, With Gravel, Moist	ML	5-5-9 N=14	14	
	10			4	2			5-2-5 N=7	4	
720						Light Brown Medium to Fine Sand, Damp				
	15			5	3			10-16-14 N=30	4	
715										
	20			6	12			9-12-15 N=27	3	
710										
	25			7	12			10-14-19 N=33	4	
705							SP			
	30			8	12			9-2-16 N=18	2	
700										
	35			9	12			10-17-21 N=38	2	
695										
	40			10	14			10-15-16 N=31	3	
690										
	45			11	14			12-16-21 N=37	2	

End of Boring at 45'

Cave In at 35.5'



Completion Depth: 45.0 ft
Date Boring Started: 9/4/15
Date Boring Completed: 9/4/15
Logged By: SB
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Big ATV
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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LOG OF BORING B-05

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Force Main - River Bend Rd

WATER LEVELS

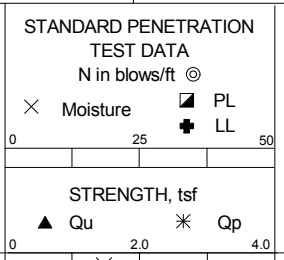
While Drilling	Not Obvd.
Upon Completion	Not Obvd.
Delay	N/A

Station: N/A
Offset: N/A

Surface Elev.: 697 ft

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil Fill (3"± Thick)	FILL		18	
695				1	6	Fill, Brown Sandy Silt, Trace Clay, With Gravel, Damp	FILL	3-3-9 N=12	9	
	5			2	6	Fill, Brown and Reddish Brown Lean Clay, With Sand and Gravel, Moist to Damp	FILL	9-9-9 N=18	8	
690				3	8	Possible Fill, Brown Lean Clay to Sandy Lean Clay, With Sand and Silt Pockets, Trace Gravel, Very Moist		11-6-3 N=9	20	
	10			4	12		PFILL	3-3-3 N=6	25	
685						Gray Fine Sand and Gravel, Moist	SP			
	15			5	3			12-12-13 N=25	4	
						End of Boring at 15'				

Cave In at 12'



Completion Depth:	15.0 ft
Date Boring Started:	9/4/15
Date Boring Completed:	9/4/15
Logged By:	SB
Drilling Contractor:	PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Big ATV
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

Professional Service Industries, Inc.
821 Corporate Court
Waukesha, WI 53189
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Fax: (262) 521-2471

LOG OF BORING B-06

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Force Main - 17th Avenue

WATER LEVELS

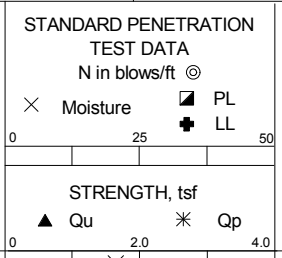
While Drilling	Not Obvd.
Upon Completion	Not Obvd.
Delay	N/A

Station: N/A
Offset: N/A

Surface Elev.: 712 ft

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil (3"± Thick)	OL		21	
710				1	8	Reddish Brown Lean Clay, With Silt Lenses, Trace Sand and Gravel, Moist	CL	2-2-2 N=4	16	
	5			2	10			2-2-4 N=6	25	Q_r = 2.6 tsf
705				3	14	Brown to Light Brown Lean Clay, Trace to With Sand, With Silt Seams, Trace Gravel, Very Moist to Moist		3-4-5 N=9	15	
	10			4	14		CL	4-3-5 N=8	23	
700										
	15			5	8			3-3-3 N=6	22	
						End of Boring at 15'				

Cave In at 7'



Completion Depth:	15.0 ft
Date Boring Started:	9/4/15
Date Boring Completed:	9/4/15
Logged By:	SB
Drilling Contractor:	PSI, Inc.

Sample Types: Auger Cutting, Split-Spoon, Rock Core, Shelby Tube, Hand Auger, Calif. Sampler, Texas Cone

Latitude:
Longitude:
Drill Rig: Big ATV
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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Waukesha, WI 53189
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LOG OF BORING B-07

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Force Main - 17th Avenue

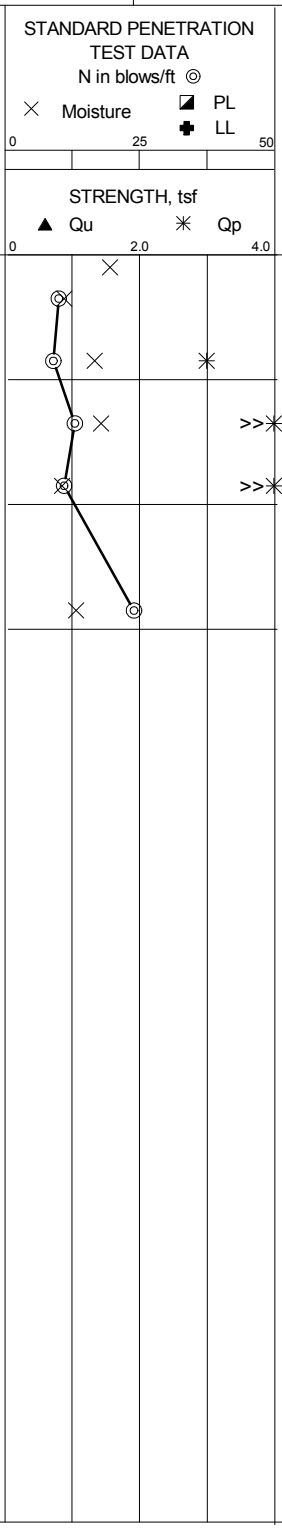
WATER LEVELS
While Drilling Not Obvd.
Upon Completion Not Obvd.
Delay N/A

Station: N/A
Offset: N/A

Surface Elev.: 761 ft

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0					Topsoil Fill (4"± Thick)	FILL		20	
760				1	10	Fill, Reddish Brown and Brown Sandy Lean Clay, With Sand and Gravel, With Silt Pockets, Damp to Moist	FILL	7-5-5 N=10	11	
	5			2	10	Reddish Brown to Brown Lean Clay, Trace Sand and Gravel, With Silt Lenses, Moist		5-4-5 N=9	17	
755				3	14			5-5-8 N=13	18	>>
	10			4	14		CL	5-5-6 N=11	11	>>
750										
	15			5	1			9-12-12 N=24	13	
						End of Boring at 15'				

Cave In at 10'



Completion Depth: 15.0 ft
Date Boring Started: 9/4/15
Date Boring Completed: 9/4/15
Logged By: SB
Drilling Contractor: PSI, Inc.

Sample Types:
Auger Cutting
Split-Spoon
Rock Core
Shelby Tube
Hand Auger
Calif. Sampler
Texas Cone

Latitude:
Longitude:
Drill Rig: Big ATV
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

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821 Corporate Court
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LOG OF BORING B-08

PSI Job No.: 00521331
Project: Proposed River Bend Road Reconstruction
Location: Village of Grafton, WI

Drilling Method: Hollow Stem Auger
Sampling Method: 2-in SS
Hammer Type: Automatic
Boring Location: Force Main - 17th Avenue

WATER LEVELS

While Drilling	Not Obvd.
Upon Completion	Not Obvd.
Delay	N/A

Station: N/A
Offset: N/A

Surface Elev.: 794 ft

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) / STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					Asphalt (4"± Thick)	ASPH		6		
				1	6	Aggregate Base, Light Brown Crushed Stone, Moist (12"± Thick)	BASE	2-1-2 N=3	23		
790	5			2	10	Possible Fill, Brown and Dark Gray Lean Clay, Trace Sand, Moist to Very Moist	PFILL	4-3-5 N=8	21		
				3	12	Brown and Reddish Brown Lean Clay, Trace Sand and Gravel, With Silt Lenses, Moist to Damp		5-8-10 N=18	17	>>	
785	10			4	14		CL	8-10-14 N=24	14	>>	
780	15			5	12			9-5-8 N=13	19		

End of Boring at 15'

Cave In at 12'

Completion Depth:	15.0 ft
Date Boring Started:	9/4/15
Date Boring Completed:	9/4/15
Logged By:	SB
Drilling Contractor:	PSI, Inc.

Sample Types:
- Auger Cutting
- Split-Spoon
- Rock Core
- Shelby Tube
- Hand Auger
- Calif. Sampler
- Texas Cone

Latitude:
Longitude:
Drill Rig: Big ATV
Remarks:

The stratification lines represent approximate boundaries. The transition may be gradual.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

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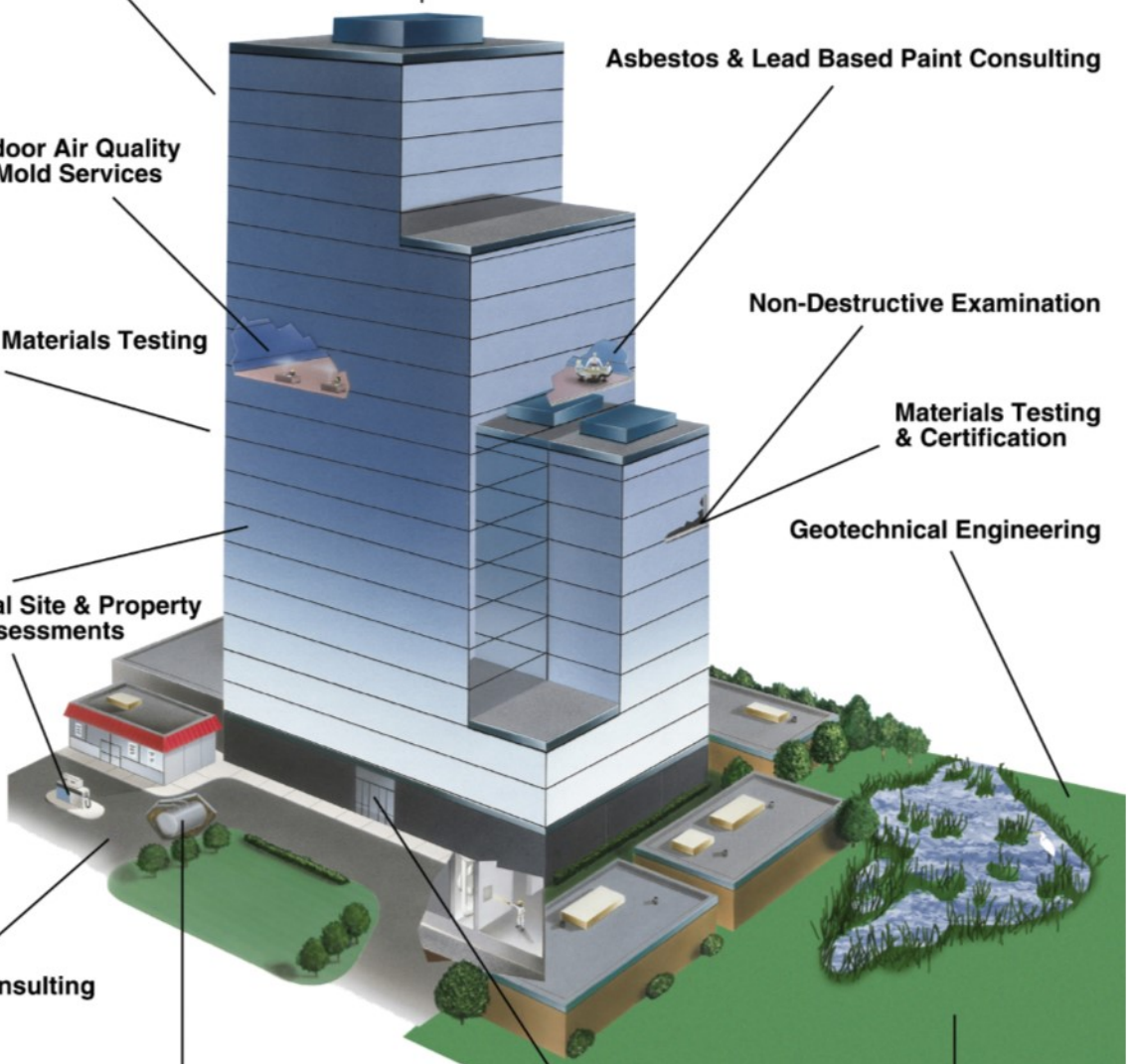

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