SPECIFICATIONS

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PUBLIX SUPER MARKETS, INC.
WASTEWATER PRETREATMENT UPGRADES
DACULA, GEORGIA

VOLUME 1

INVITATION TO BID

PUBLIX SUPER MARKETS, INC.
WASTEWATER PRETREATMENT UPGRADES
DACULA, GEORGIA

OWNER: Publix Super Markets, Inc. (Publix) hereby gives notice that sealed bids will be received for the construction of upgrades to the wastewater pretreatment facilities at the Publix distribution center in Dacula, Georgia.

TIME: Sealed bids will be received until 6 p.m., local time, on May 5, 2016, at the office of Monte Jones, Publix Super Markets, Inc., at which time all bids will be privately opened. Refer to Section 00200, Instructions to Bidders, subsection 10, for instructions for submission of hard copy and electronic bids.

Entire Bid Forms are to be delivered as follows:

Original Bid:

1. Publix Super Markets, Inc.
   445 Hurricane Trail
   Dacula, GA 30019
   Attn: Mr. Monte Jones
   Project Manager
   Monte.Jones@publix.com
   Ph: 770-995-0073 ext. 30354

Copy of Bid:

1. Applied Technologies, Inc.
   16815 West Wisconsin Avenue
   Brookfield, WI 53005
   Attn: Ed Longhini
   Project Engineer
   ealonghini@ati-ae.com
   Ph: 262-784-7690

PROJECT: The Work, officially known as "Wastewater Pretreatment Upgrades" consists of improvements to the existing wastewater pretreatment facilities, and installation of new wastewater equalization and aeration equipment. The work also includes demolition and restoration, concrete work, piping work and modifications, electrical work, instrumentation and control work, and miscellaneous work required to accomplish the upgrades. Refer to Section 01100 for more information.

BIDDING DOCUMENTS: One set of Bidding Documents will be provided in electronic format to each invited Bidder. Additional sets of the Bidding Documents may be obtained via email from Applied Technologies, Inc. Bidders shall include their name, address, e-mail address, and telephone number with their request for additional Bidding Documents.

PREBID MEETING & SITE VISITS: There will be a mandatory Prebid meeting at the Publix Dacula site, to be scheduled by Publix during the Prebid period. If needed, additional onsite visits prior to bidding may be available upon request. Contact Mr. Monte Jones at Publix to obtain approval and make arrangements.

SUBSURFACE INVESTIGATION REPORTS: Included in the Bidding Documents.

DOCUMENT CLARIFICATIONS: Any questions regarding the RFB shall be addressed in writing or email to Mr. Monte Jones at (Monte.Jones@publix.com), and to Mr. Ed Longhini, Applied Technologies, Inc. at (ealonghini@ati-ae.com).

BID REJECTION/ACCEPTANCE: Publix reserves the right to reject any and all Bids, waive any informalities in submittals or to accept the Bid, whichever best serves the interests of Publix.

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

Published by authority of Publix Super Markets, Inc.

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS

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 the Bidding Documents must be used in preparing a Bid; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete 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. ITEMS TO BE SUBMITTED WITH BID

3.1. 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. A completed Bid Form (Section 00410) with all Schedules filled-in.

3.3. A milestone schedule showing key project dates and proposed completion date.

3.4. A list of any technical clarifications.

3.5. A review of the draft Publix Master Construction Agreement (see Appendix) and a list or redlines of any deviations.

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

3.7. A listing of property and heavy equipment available to the Bidder so that an evaluation can be made as to the Bidder’s ability to complete the Work in accordance with the Bidding Documents.

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

3.9. A minimum of 3 References of similar projects completed. Provide a brief description of the project, location, contact name, and contact telephone number.

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

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

3.12. A list of Contracts defaulted.

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

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

3.15. Provide resumes of key 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.

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

3.17. 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. 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.

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

4. EXAMINATION OF BIDDING 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 Meeting, if scheduled, will be held as stated in the Invitation to Bid. A tour of the existing site will follow the meeting.

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

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.

4.4. 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.

4.5. 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.

4.6. 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.

4.7. 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 Bidding Documents shall be submitted to Owner and Engineer in writing on the Request for Information (RFI) form located in Bidding Documents, not less than five days prior to the date for opening of Bids. Replies will be issued via email or otherwise delivered to all parties recorded by Engineer as having received the Bidding Documents. No response will be provided to a Bidder's oral or email questions. Any information provided to Bidders other than by means of RFIs and the Bidding 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 for, nor shall the giving of any such information entitle the Bidder to assert any claim or demand against Owner or Engineer on account thereof. The Engineer shall provide clarifications to all Bidders such that all Bidders receive the same information during the bidding process.

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 become part of the Contract Documents. Include resultant costs in the Bid.

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

6. CONTRACT TIME

6.1 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.

7. LIQUIDATED DAMAGES

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

8. SUBCONTRACTORS, SUPPLIERS AND OTHERS

8.1 The 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). The Bidder shall provide information clearly demonstrating the ability of those identified to successfully perform the work proposed.

9. BID FORM

9.1. The Bid Form is included in these Bidding Documents and must be included in any Bid submitted.

9.2. All blanks on the Bid Form must be completed in black ink or typed. 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 any alternatives listed on the Bid Form must be filled in.

9.3. When required by and in the manner provided on the Bid Form, Bid shall provide additional price detail.

9.4. All work described in the Bidding Documents shall be included within the Lump Sum Bid Price. Additional bid price detail requested shall be for Owner's information.

9.5. Bids by corporations must be executed in the corporate name by corporate officer 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.

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

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

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

10. SUBMISSION OF BIDS

10.1 Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in a sealed envelope, marked with the Project title and name and address of the Bidder. 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.

10.2. The Bid Form and all attachments may be emailed, at or before the time and date stipulated, to all the bid recipients described in the Instructions to Bidders. Hard copies of the Bid Form with original signatures shall subsequently be delivered to Owner within three (3) business days of the Bid Date. Hard copies do not have to be provided to the persons listed in the Instructions to Bidders as recipients of copies if emailed Bids are provided to them.

10.3. All Bid documents submitted by the Bidder shall contain the completed Bid Form.

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

11. MODIFICATION AND WITHDRAWAL OF BIDS

11.1. Bids may be modified or withdrawn by written communication delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

11.2. Withdrawn Bids may not be resubmitted unless the Bidder is notified that revised Bidding Documents are being distributed to all bidders.

12. OPENING OF BIDS

12.1 Bids will be opened privately by Publix Super Markets, Inc. Bid information will not be made available.

13. BIDS TO REMAIN SUBJECT TO ACCEPTANCE

13.1 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.

14. AWARD OF CONTRACT

14.1. 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.

14.2. 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 fails to meet any other standard or criteria established by Owner.

14.3. 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.

14.4. 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.

14.5. Owner may consider the qualifications and experience of major Subcontractors proposed for portions of the Work as provided in the Bid Form. 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 is required to be submitted prior to the Notice of Award.

14.6 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 Bidder, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Bidding Documents to Owner's satisfaction within the prescribed time.

14.7 If the contract is to be awarded, it will be awarded to the qualified, responsive, and responsible Bidder based on the evaluation by Owner which indicates that the award will be in the best interests of the Project.

15. CONTRACT SECURITY AND INSURANCE

15.1 The Publix Master Construction Agreement sets 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 any required performance, and payment Bonds, and evidence of insurance.

16. SIGNING OF AGREEMENT

16.1 After 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 10 days thereafter Contractor shall sign and deliver at least 3 counterparts of the Agreement and attached documents to Owner with any required Contract security. Within 10 days thereafter Owner shall deliver one fully signed counterpart to Contractor.

17. SALES AND USE TAXES

17.1. Bidder shall investigate the statutory requirements for payment of sales and use taxes and if required shall include taxes in the Bid.

17.2. 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.

BID FORM

PROJECT IDENTIFICATION: WASTEWATER PRETREATMENT UPGRADES
DACULA, GEORGIA

THIS BID IS SUBMITTED TO: Publix Super Markets, Inc.
445 Hurricane Trail
Dacula, GA 30019

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner (see draft Agreement in Appendix) 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. 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 10 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.

(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.

(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.

(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.

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

TOTAL BASE BID:

The Bidder agrees to complete the Total Base Bid work for each type and unit of work called for in the Contract Documents including all equipment and allowances set forth in the Contract Documents, 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 _____weeks from the date when the Contract Time commences.

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) Schedule A – Bid Price Breakdown

(b) Schedule B - Subcontractor Listing

(c) Schedule C – Experience Modification Rate (EMR)

(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.

7. Communications concerning this Bid shall be addressed to:

Name: _____

Company Name: _____

Address: _____

Email: _____

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:

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.: _____

_____
Notary or Other Officer Authorized To
Administer Oaths

My commission expires: _____

SCHEDULE A
BID PRICE BREAKDOWN

Item	Price
Mobilization & General Conditions	
Site Earthwork & Paving	
Under Ground Piping	
Above Ground Piping	
Structural Concrete	
Electrical Installation	
Mechanical Installation	
Precommissioning & Testing	
Field Erected Tanks	
Transfer Pumps	
Mixer	
Biological Odor Control	
Instrumentation & Controls and MCC	
Sales Tax	
Insurance	
TOTAL	

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 _____

Civil 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 _____

SCHEDULE C
EXPERIENCE MODIFICATION RATE (EMR)

Bidder certifies that its EMR rating for the past 3 years is as listed in the table below:

Year	EMR
2014	
2015	
2016 (Projected)	

Bidder to provide explanation as to EMR ratings of greater than 1.0 in the space below:

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 an upgraded wastewater pretreatment system including expanded equalization volume and additional aeration 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. Connections to existing buried process wastewater sewer line.
2. Installation of two new submersible influent pumps with accessory equipment in existing influent pump station.
3. Re-routing of influent pump discharge piping and valves.
4. Installation of a new equalization (EQ) tank with submersible mixer.
5. Installation of a new influent wastewater dual strainer unit.
6. Installation of a new odorous air treatment system for EQ tank.
7. Installation of a new aeration blower package and piping in existing building.
8. Instrumentation and control work including interface with existing controls.
9. Plumbing and miscellaneous piping work.
10. Electrical work including additions to and replacement of existing components as needed for new systems.
11. Site work including tank leakage containment.
12. Yard piping work.
13. Selected demolition of existing facilities.

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 pretreatment plant site and maintain pretreatment plant operations. Contractor shall coordinate construction operations to allow Owner continued operation of existing pretreatment plant.

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. Coordinate with the Owner to facilitate access to the site for workers, subcontract personnel, construction vehicles, inspections, sanitary and trash services, deliveries, and visitation. Facility access is controlled. Comply with all Owner security procedures and requirements.

G. All workers, subcontractors, drivers and visitors shall adhere to Contractor's safety program and OSHA guidelines.

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

I. 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 in coordination with the Owner without prior permission.

J. All power and other utility outages shall be scheduled and coordinated with the Owner to minimize or avoid interruptions to plant operations.

K. 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. The existing wastewater treatment facilities must be maintained in operation during construction. Degree of treatment during construction shall be equal to or exceed efficiency of facility 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 wastewater treatment 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 treatment.

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 treatment. The Contractor shall conduct his operations in a manner necessary to minimize disturbance or disruption of wastewater treatment processes or operations.

1. The Contractor's construction schedule for the Work shall generally be as follows:
    a. Construct new treatment facilities and perform work in existing facilities in coordination with other work.
    b. Construct yard piping, site utilities, and complete site work to make new facilities completely operational.
2. The general sequence of construction outlined must permit efficient use of the existing facilities during construction and to expedite construction and operation of the new facilities.
3. The sequence of operations shall be conducted such that sufficient treatment facilities are in service to maintain plant operations throughout the duration of the construction.
4. 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 plant 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, water utilities, process wastewater sewer, and effluent sewer. Contractor shall be responsible for disconnecting the piping, draining liquid from the piping if necessary, and cleanup of the area.

E. For any extended interruption of an existing plant system, Contractor shall provide temporary supply, storage, conveyance, disposal and other services sufficient to maintain plant operation during the interruption. Contractor shall submit plan and receive approval from the Owner for temporary services well in advance of any planned interruption.

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

1.6 OWNER OCCUPANCY

A. The Owner will occupy the existing treatment plant site 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 OFF SITE SPOILS DISPOSAL

A. Excess spoils from excavations shall be removed from site and disposed of in accordance with all applicable laws and regulations.

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. 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 Owner/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 Owner/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: **NONE**

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 Owner/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 Owner/Engineer.

D. Testing and Inspecting Allowances Schedule:
1. NONE

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

1.4 SCHEDULE OF VALUES

A. Submit printed schedule on EJCDC C-620-2013. 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 C-620-2013. Contractor's electronic media driven form 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 Owner/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.

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 Owner/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 Owner/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 Owner/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 Owner/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: Owner/Engineer may issue directive 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. Owner/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 C-941 Change Order.

O. Execution of Change Orders: Owner/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. Owner/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 Owner/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 Owner/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. Contractor 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 Owner/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. Owner/Engineer will schedule meeting after Notice to Proceed.

B. Attendance Required: Owner, 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 Owner/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 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, 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 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 Owner/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 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 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 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 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.

K. Construction photographs.

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 business address. Coordinate submission of related items.

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 or illegible copies of materials 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 $105 per hour for Engineer review time.

O. Submit four (4) copies of all construction submittals; each copy must bear the Contractor's approval stamp and signature. Two (2) copies of submittals will be retained by the Engineer and the remaining copies returned to the Contractor. The Contractor shall maintain one complete set of approved Submittals at the job sire and one complete set for Record Documents as described in Section 01700.

Alternatively, the Engineer may approve use of electronic submittals. For this method to be approved, Contractor shall supply and manage a secure file sharing website through an established and reputable provider such as DropBox or equal. Site shall be well organized, compartmented and labeled with timely updates as needed. Owner and Engineer shall be given all capabilities necessary for efficient file handling.

Complete copies of each submittal shall be posted individually to the website and Owner and Engineer notified immediately upon posting of each submittal. Each electronic submittal file shall contain all materials and documentation required by this Section. Partial submittals or submittals by other than the Contractor will not be accepted. Emailed submittals will not be accepted. Where product samples or color selection is required, physical materials shall be submitted. All other requirements of this Section apply.

P. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

Q. Submittals not requested 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 in duplicate 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 Owner/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 Owner/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Owner or 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 Owner/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Owner/Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Owner will employ services of an independent firm to perform testing and inspection.

B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner/Engineer.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Engineer or Owner.

D. Reports will be submitted by independent firm to Owner/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 Owner/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 Owner/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 Owner/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 Owner/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Owner/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 Owner/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 Owner/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 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 regulation.

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   3. Security.
   4. Water control.
   5. Dust control.
   6. Erosion and sediment control.
   7. Pollution control.

D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Contractor shall provide temporary electrical power for use during construction.

B. Provide main service disconnect, over current protection, distribution and receptacles at convenient locations.

C. As applicable permanent power supply and convenience receptacles at existing facility may be utilized during construction with Owner approval.

D. Replace any components damaged during construction.

E. Complement existing power service capacity and characteristics as required for construction operations.

F. 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.

D. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY HEATING

A. Existing facilities shall not be used.

B. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

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. Provide, maintain, and pay for telephone service to field office at time of project mobilization. Owner's phone service will not be available.

1.7 INTERNET / FACSIMILE SERVICE

A. Provide, maintain and pay for internet / facsimile service to field office at time of project mobilization.

1.8 TEMPORARY WATER SERVICE.

A. Owner will provide temporary water for construction purposes. Exercise measures to conserve water. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.

B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

C. Coordinate with Owner to provide bulk water for tank testing purposes.

1.9 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.10 VEHICULAR ACCESS

A. Existing roadways within the plant must remain open at all times to allow for normal plant operations. Continuous access to existing plant buildings must be provided at all times. Notify the Owner at least 48 hours prior to taking any roadway section out of service.

B. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

C. Provide unimpeded access for emergency vehicles.

D. Provide and maintain access to fire hydrants free of obstructions.

E. Provide means of removing mud from vehicle wheels before entering streets.

F. 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, and mud.
   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. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.13 PROJECT IDENTIFICATION

A. No signs will be allowed without Owner permission, except those required by law.

1.14 TRAFFIC REGULATION

A. Signs, Signals, And Devices:
   1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by authority having jurisdiction.
   2. Automatic Traffic Control Signals: As approved by local jurisdictions.
   3. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
   4. Flag Person Equipment: As required by authority having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:
   1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
   2. Confine construction traffic to designated haul routes.
   3. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

E. Traffic Signs and Signals:
   1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
   2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
   3. Relocate as Work progresses, to maintain effective traffic control.

F. Removal:
   1. Remove equipment and devices when no longer required.
   2. Repair damage caused by installation.

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. Provide security fencing around construction at Contractor's option.

B. Access to the site and portions of the work are within the existing plant perimeter fence. Contractor may provide additional security fencing around construction. Coordinate use of existing entrance gates with the Owner.

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.

C. Provide temporary partitions/barriers to protect existing equipment and facilities from dust during interior demolition and construction.

1.20 EROSION AND SEDIMENT CONTROL

A. General: Comply with local rules and policies promulgated or developed for construction site erosion and sediment control.

B. General Erosion Control Measures:
1. Install and maintain erosion control devices during construction as required by local rules and policies.
2. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
3. Minimize surface area of bare soil exposed at one time.
4. Provide temporary measures including berms, dikes, and drains, and other devices to divert stormwater away from disturbed or exposed areas.
5. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

6. Soil and sediment deposited on pavements must be sweep cleaned at the conclusion of each day’s operation.
a. Maintenance shall be completed as soon as possible with consideration to site conditions.

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.

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 Internet: 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 OWNER/ENGINEER USE

A. Contractor shall provide a separate space in the Contractor’s trailer for use of Owner or Engineer when needed, with phone, power and internet facilities available.

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 parking as specified in Section 01500, 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.

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 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 Owner and 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 PLANT START-UP

A. Clear Water Test Period:
   1. The Clear Water Test shall simulate full-scale plant operations with all basins, pipelines, and equipment in service for a minimum 3 consecutive days. Water for Testing: Treated plant effluent may be available for use by the Contractor, coordinate with Owner. Contractor shall provide temporary pumping and piping facilities to transport water. Dispose of test water by pumping to the plant drain system. Disposal of water used in testing shall be the Contractor's responsibility.
   2. The Clear Water Test 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 clear water test.
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.

3. Clear water testing of all new equipment and systems is required. Fill tanks to the maximum operating level and operate all pumps and associated equipment.
4. During execution of the clear water test, specified pump performance and field tests and other tests approved by the Engineer may be performed.
5. Contractor shall correct equipment and system deficiencies that arise during clear water testing.

B. Wastewater Start-up Period:

1. Start-up of the new facilities with raw well water includes coordinated operation of the facilities by the Contractor, his subcontractors, Owner-operating personnel, and manufacturer's representatives for equipment items and systems.
2. 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.
3. 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 finished water start-up period.
4. 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.
5. The Contractor shall conduct performance tests on all equipment, systems, and subsystems not previously tested and approved by the Engineer.
6. The Contractor shall be responsible for adjustments, repairs, and corrections of specified work.
7. The Owner will provide and pay for the necessary electrical service and chemicals used during the wastewater start-up and operation periods. The Contractor shall coordinate the procurement and delivery of such items with the Owner.
8. Following the successful start-up of plant 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.

9. Provide skilled trades crew for performance of work as directed by the Owner and/or Engineer during startup.
10. 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 Owner/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.

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 Owner/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 FACILITIES TO BE MODIFIED

A. Contractor shall clean wastewater residues and solids from all vessel walls, floors, and piping prior to beginning construction.

B. Owner will empty vessel contents prior to Contractor commencing work. Contractor shall provide ventilation and means required to enter the vessel. Contractor shall comply with OSHA rules for confined space entry.

C. Contractor to provide additional cleaning as required for proper construction.

D. Flush and drain all piping to be modified prior to construction.

E. Dispose of all solid waste in an approved landfill.

3.2 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 or sooner 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.

3.3 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 Owner or Engineer to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

3.4 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 Owner/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

A. Not used.

PART 3 EXECUTION

A. Not used.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Format and content of manuals.

B. Equipment data form.

C. Operation and maintenance manual submittal checklist.

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 Cover Page that provides the following information:
1. Title of project.
2. Specification number and title.
3. Manufacturer.
4. General Contractor.
5. Subcontractor.
6. Supplier.

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 or illegible 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; names, addresses, and telephone numbers of Engineer, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers 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.

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 payment for equipment delivered, stored or installed under these Contract Documents will not be made until copies of O&M data are delivered to and approved by ENGINEER. Progress payments for control system packaged with equipment will not be made until O&M data is incorporated into equipment and control system manual delivered to 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).

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_____		

EQUIPMENT DATA FORM (Page 2 of 3)

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

_____

_____

_____

O&M MANUAL SUBMITTAL CHECKLIST (Page 1 of 5)

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 suppplier 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 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 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.

B. Remove trees and shrubs within marked areas and as indicated. Remove trees, shrubs, stumps, surface rock, and roots.

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.

C. Remove abandoned utilities within limits of construction or as shown. Indicated removal termination point for underground utilities on Record Documents.

D. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

E. 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.

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.

C. Materials Source: Submit name of imported materials suppliers.

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, relandscaped, or regraded, without mixing with foreign materials for use in finish grading. In areas to be regraded with excess fill, strip 6 inches of 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. Remove excess topsoil not intended for reuse, from site.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

C. Stockpile excavated material in area designated on site and protect from erosion.

D. Benching Slopes. Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.

E. Stability: Replace damaged or displaced subsoil as specified for fill.

F. 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, that were damaged by excavation or filling.

3.6 TOLERANCES

A. Section 01400 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing and inspection services.

B. Testing: In accordance with ASTM D698, ASTM D2922 and ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest 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.

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 all below grade structures.
   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. Excavate to working elevation for piling work.

E. Compact disturbed load-bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02320 and 02324.

F. Slope banks with machine to angle of repose or less until shored.

G. Do not interfere with 45 degree bearing splay of foundations.

H. Grade top perimeter of excavation to prevent surface water from draining into excavation.

I. Trim excavation. Remove loose matter.

J. Remove lumped subsoil, boulders, and rocks.

K. Notify Architect/Engineer of unexpected subsurface conditions.

L. Correct areas over excavated as specified in Section 02320. As directed by Architect/Engineer.

M. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.

N. Remove excess and unsuitable material from site.

O. Removal of Water: The contractor shall provide and operate a dewatering system as necessary to prevent water from entering any excavations. 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. 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. The costs of all sumps, wells, well points, piping, pumping, excavation, and other work associated with dewatering shall be borne by the Contractor. Contractor shall acquire all permits necessary for construction, operation, and removal of dewatering systems.

P. 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.

B. Coordinate this Section with recommendations provided in Geotechnical Investigation Report, included in the Appendix.

1.2 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.

1.3 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:

1. 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

Gradation Requirements for Crushed Stone:

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 grade 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: 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 of 30 and a Plasticity Index of 15(ASTM D4318-10). 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. 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 R: Shall comply with applicable Georgia DOT specifications for use with 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, 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.

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 3 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 Landscaped areas and fill for Berm:
   1. Common fill, to 12 inches below finish grade, compacted to 85 percent.

E. 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.

F. Fill to Correct Over-excavation:
   1. Structural fill, flush to required elevation, compacted to 95 percent.

G. Fill to Prevent Erosion:
   1. 12-inch minimum rip rap placed over non-woven geotextile Type R

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 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).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 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.

1.5 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.

C. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.6 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. Not used.

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 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 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.

1.4 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.

1.5 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, ASTM E1745 Class C Vapor Retarder.

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. Sherwin Williams: Topcoat of Heavy Duty Epoxy B67-B60B3 (epoxy polyamide). Note: Self-priming.
   2. 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.

P. Vapor Retarder Installation:
1. Install vapor retarder in accordance with manufacturer's suggested procedures.
2. Provide vapor retarder manufacturer's accessories for proper vapor retarder installation.
3. Lap joints minimum of 6" and seal with approved tape.
4. Seal edges and penetrations through vapor retarder in accordance with manufacturer's recommendations.

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. Repair damage to structure caused by early removal of forming and shoring at no additional cost to Owner.

D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

E. 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.

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 Superior, D368 Taper-Lock Form Saver manufactured by Dayton Superior 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.

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
   a. 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.
   b. Notify Engineer a minimum of 24 hours prior to the commencement of concrete placement.
   c. 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. Provide joint materials as indicated on drawings and specified herein. Materials specified within this section may not all be required within the project.

C. 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.

a. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

D. 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.

a. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

E. 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.

a. Provide factory made prefabricated tees, crosses and other configurations as required. Splice in accordance with manufacturer's recommendations.

F. 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.

G. 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.

H. 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.
   a. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer.
   b. Limit size of concrete pours. Maximum length of wall and slab pours shall not exceed 60 feet.
   c. 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.
   d. Construction joints in beams shall be offset a minimum distance of 2 times the width of intersecting beams.
   e. 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.
   f. 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.
      1) Cut alternate reinforcing bars or wires crossing joint
      2) Provide preformed control strip in full length unspliced pieces unless a special splice designed to prevent misalignment of splice joint is used.
      3) Control joints shall be ¼ depth of slab, unless shown otherwise on Drawings.
      4) Fill construction joint, tooled joint and sawed joints with epoxy joint filler.

B. Provide waterstop in construction joints in:
   a. Walls and slabs separating dry interior from earth or liquid.
   b. Exterior walls of liquid holding tanks
   c. Floor slabs above occupied areas
   d. Other locations shown on the Drawings.

C. Install waterstops continuous without displacing reinforcement. Heat seal joints watertight.
   a. 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, and patching mortar.

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 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.

F. 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.

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. Concrete repair mortars: One component, polymer-modified, cementitious patching material. SikaRepair 222/223 by Sika Corporation;

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)	1½ 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, 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)	1½ inch
Air Entrained	4 to 6 percent

Admixture	Water reducing type
Admixture	Integral 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
Admixture	Water reducing type
Slump	3 to 6 inches

F. Use accelerating admixtures in cold weather only when approved. Use of admixtures will not relax cold weather placement requirements.

G. Use calcium chloride only when approved by the Engineer.

H. Use set retarding admixtures during hot weather only when approved by the Engineer.

I. 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.

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 a1/2 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 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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.

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. 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 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 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.

C. 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.

D. 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, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

C. 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 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.

2.8 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.

2.9 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.

2.10 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.

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 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 samples and product data under provisions of Section 01330.

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 two sets of samples illustrating colors. Color selected by Engineer.

D. Submit manufacturer's installation instructions under provisions of Section 01330.

E. 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 Section 01330.

B. Locate where directed.

C. Accepted samples 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 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.

B. Type 7: One-Part Silicone, Nonsag, Not Immersible: FS TT-S-01543, Class A, No. 790 manufactured by Dow Corning; 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
B.	Material Joints at:	
	Wall Penetrations (Exterior)	7
	Wall Penetrations (Interior)	7
	Floor Penetrations	5
	Ceiling/Roof Penetrations	7
C.	Other Joints:	
	Immersed Concrete (Vertical and Sloped, not in contact with potable water)	5
	Immersed Concrete (Horizontal, not in contact with potable water)	5

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 either shown on the Drawings or will be selected by the Owner, unless otherwise 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

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
120	Exterior Concrete Tank Coating

System No.	Title
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. 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. None

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

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.

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.

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.

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. Not Used.

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. Not Used.

N. System No. 27, Aluminum and Dissimilar Metal Insulation: This system shall be used on all non-submerged 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. Not Used.

P. System No. 107, Metal Trim and Structural Steel: This system shall be used on the following items or areas:
   1. Not Used.

Q. System No. 109, Concrete Masonry, Gloss: This system shall be used on the following items or areas:
   1. Not Used.

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. Not Used.

T. System No. 115, Gypsum Wallboard and Plaster, Gloss: This system shall be used on the following items or areas:
   1. Not Used.

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 11316

SUBMERSIBLE PUMPS-DRYER ROOM DISCHARGE PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submersible Pumps:
   1. New Influent Pump Station Pumps:
      a. P-1-1
      b. P-1-2

B. Local Control Panel
   a. Existing CP-100

C. Major components included, but not limited to:
   1. Pump and motor.
   2. Mounting system.
   3. Instrumentation and control.
   4. Spare parts.

1.2 SYSTEM DESCRIPTION

A. New influent pumps and mounting system shall be installed in the existing influent pump station, to replace the existing pumps. New pumps shall be capable of pumping influent from the pump station into the new equalization tank. Replacement pump motors will be higher horsepower rated, requiring new starters and other controls in the existing local panel CP-100.

1.3 REFERENCES

A. Hydraulic Institute Standards.

B. ASTM A 108 - C41 - Specification for Steel, Carbon, Cold-Rolled Standard Quality.

C. ASTM A 48 - Gray Iron Castings.

D. AFBMA Std. 9 - Load Ratings and Fatigue Life for Ball Bearings.

E. AFMBA Std. 11 - Load Ratings and Fatigue Life for Roller Bearings.

1.4 DESIGN REQUIREMENTS

A. General Requirements:
   1. Liquid pumped: Dairy processing wastewater including CIP
   2. Pump Installation: Submersible.
   3. Specific gravity of liquid: 1.0.
   4. Maximum liquid temperature (F): 130° estimated.
   5. Percent solids (%): <0.5.

6. Discharge size: 6-inch maximum.

B. Hydraulic Requirements:
   1. Design flow, gpm: 525
   2. Design TDH, feet: 60

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:
      a. Capacity.
      b. Head.
      c. Horsepower.
      d. Efficiency.
   2. Pump data and dimensions.
   3. Impeller type.
   4. 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.

1.7 WARRANTY

A. Warrant the equipment to be free from defects in material and workmanship within one-year after installation and manufacturer's startup.

B. If found defective, manufacturer shall promptly, without cost to Owner and in accordance with Owner's written instructions: repair or replace equipment, and satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or areas resulting there from.

C. If manufacturer does not promptly comply with the terms of instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective equipment repaired or replaced, and 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 the manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Xylem/Flygt Corporation, Pewaukee, WI.

B. Or Approved 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.

B. All submerged equipment shall be constructed of materials suitable for moderately corrosive service.

2.3 METAL FABRICATION

A. Furnish metal parts described herein conforming to Section 05500.

B. Anchor bolts, fasteners, nuts, and washers: 316 stainless steel.

2.4 EQUIPMENT

A. Motors:
1. Motor nameplate horsepower: 10 HP (estimated).
2. Enclosure: Submersible.
3. Stator windings, stator lead insulation: Moisture resistant Class H insulation or Class F insulation.
4. Power: 460 VAC, three phase, 60 Hz.
5. Starting torque and starting current: NEMA B type.
6. Service Factor: 1.15.
7. Air filled.
8. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered, throughout the entire pump performance range.

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): 30 feet.

C. Pump Construction:
1. Pump volute, motor and seal housings:
a. Construction: Close-grained cast iron ASTM A 48 Class 25 or 30.
b. Seals: External mating parts machined and fitted with Nitrile or Viton rubber O-rings.
c. Exposed fasteners: AISI Type 304 or 316 stainless steel.
d. Volute casing to have a stainless steel wear ring.

2. Shaft:
   a. Construction: Solid machined 416 or 420 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: Grease for air filled motor housing, dielectric oil bath for oil filled motor housing.
4. Mechanical seal:
   a. Number of seals: Two.
   b. Type: Mechanical with carbon rotating seal faces and ceramic stationary seal faces.
   c. Mounting: Tandem with an oil chamber between seals.
   d. Lubrication: Oil bath.
5. Impeller:
   a. Construction: close-grained cast iron ASTM A 48, Class 30, with stainless steel wear ring.
   b. Impeller type: Single vane designed as a non-clog impeller of manufacturer's latest design.
   c. Balancing: Dynamically balanced.

D. Base Elbows and Mounting System:
1. Discharge elbow:
   a. Provide vertical discharge with 4-inch flanged ends.
2. Guide Rails:
   a. Mounting System: Suspended through the pump cover.
   b. Number of guide rails per pump: 2.
   c. Construction: 2-inch schedule 20 stainless steel
   d. Provide all necessary mounting hardware.
3. Provide a stainless steel lifting chain for each pump.

2.5 ACCESSORIES

A. Spare Parts:
1. Gaskets and O-ring seals: One set per pump.
2. Pump seal cartridge: one.

B. Access Cover and Frame:
1. Existing. Ensure sufficient clearance for removal of new pumps through existing access cover.

2.6 FINISHING

A. Shop and Field Painting: Conform to Section 09900, System No. 2. Verify compatibility of shop prime and field paint (if necessary).

2.7 INSTRUMENTATION AND CONTROL

A. Control Panels and Components:
1. Furnish any new controls compatible with the existing control panel CP-500 and new submersible pumping system herein.

2. Existing Control Panel CP-500:
    a. Provide new motor starters, circuit breakers and any other required controls mounted within existing control panel. See drawings.
    b. Provide new wiring to local junction box and to MCC as shown in drawings.
3. Moisture Detectors: Provide one in each pump's seal area.
4. Heat Sensors: Provide heat sensors in each pump motor.
5. Special Components mounted in panel: New MINI CAS Relay to sense Pump motor overtemp condition and moisture detection, or equivalent moisture and motor high temperature protection relay(s). Replace existing relays.
6. All other existing panel and control components to be reused.

B. Functional Description:
1. High motor temperature protection:
    a. Upon the heat sensors sensing a high temperature in the motor casing the controls shall shut down the pump, indicate pump high temperature alarm, pump fail alarm and actuate the remote common fail and require manual pump reset.
2. Moisture protection:
    a. Upon the moisture sensors sensing moisture in the pump casing the controls shall indicate pump seal fail alarm.
3. Other pump control functions to remain the same as existing.

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 Division 1.

B. Minimum Service Requirements:
1. Installation: As required for proper installation.
2. Start-up and Field Testing: One half day on site.
3. Operator Training: One half day on site.
4. Post-start-up training: None required.

END OF SECTION

SECTION 11395

SUBMERSIBLE MIXERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. EQ Tank Mixer.
   1. M-1-1

B. Major Components For Each Mixer:
   1. Submersible mixers.
   2. Mounting system.

1.2 SYSTEM DESCRIPTION

A. The mixer shall be capable of thoroughly mixing the contents of the EQ tank.

1.3 DESIGN REQUIREMENTS

A. Premix Zone Mixer:
   1. EQ Tank side wall height: 31'-6".
   2. Side water depth: 30'-0".
   3. Tank volume, gal: 189,000 nominal.
   4. pH, s.u.: 6-9 normal
   5. Max. temp, °F: 130
   6. Number of mixers: one.
   7. Mixer horsepower: 4.0 hp.
   8. Motor and mixer speed: 855rpm.
   9. Prop diameter, inches: 14.5.
   10. Prop blade angle: 12°.

1.4 PERFORMANCE REQUIREMENTS
   1. Zone contents: Dairy processing wastewater including CIP.
   2. Solids concentration: ~ 0.3 to 1.0% solids.
   3. Maximum viscosity: 1,000 cps.
   4. Minimum mixer primary flow based on clear water, gpm: state
   5. Maintain zone contents uniformly mixed.

1.5 SUBMITTALS

A. Bid Submittals: Submit four (4) complete sets of bid information which include the following:
   1. Cost of equipment and work specified herein. Include FOB to plant site, Dacula, Georgia.
   2. Provide delivery time after shop drawing approval. Include shop drawing preparation and approval time.

3. Provide descriptive information on material and components furnished.
4. Provide references on similar installations at dairy processing facilities.

B. Shop drawings: Submit under provisions of Division 01, including the following:
1. Complete assembly and installation drawings.
2. Descriptive information on material and equipment furnished.
3. Complete performance data including:
   a. Flow
   b. Total power requirements in kW
4. Mixer data and dimensions.
5. Motor data.

C. Operation and Maintenance Manuals: Submit under the provisions of Division 01.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle the equipment properly and in accordance with the Manufacturer's recommendations. Unloading, storage and handling after delivery by Contractor.

1.7 WARRANTY

A. Warrant the equipment to be free from defects in material and workmanship within one-year after installation and manufacturer's startup.

B. If found defective, Manufacturer shall promptly, without cost to Owner and in accordance with Owner's written instructions: repair or replace equipment, and satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or areas resulting there from.

C. If Manufacturer does not promptly comply with the terms of instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective equipment repaired or replaced, and 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 the Manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Xylem Flygt Corporation, Pewaukee, WI.

B. Or Approved Equal.

2.2 GENERAL

A. Mixer of integral-design, close-coupled, submersible type. All components capable of continuous submerged operation to a depth of 130 feet and continuous operation in air completely unsubmerged for two (2) hours.

B. Mixer complete with mast mounting system.

2.3 STEEL FABRICATION

A. Plates and Structural Members: Type 316 stainless steel.

B. Anchor bolts, bolts, hex nuts and washers: Type 316 stainless steel.

2.4 MIXER

A. Motors:
1. Motor nameplate horsepower: 4.0 hp.
2. Type drive: Constant speed.
3. Motor rpm: 855.
4. 460 VAC, three phase, 60 Hz.
5. Mixer rpm: Same as motor speed.
6. Moisture resistant Class F insulation.
7. Continuous duty, 10 starts per hour.
8. Enclosure: Submersible.
9. The motor shall not be overloaded beyond the nameplate rating under any normal conditions encountered.
10. Temperature sensors embedded in motor windings.
11. Motor shaft: stainless steel.

B. Electrical Power and Signal Cable:
1. Type: Water proof.
2. Power cord entry to mixer: Protected with a compression fitting followed by sealed terminal board with permanently affixed binding posts.
3. Length (each): 50 feet. Actual length to be confirmed by installation contractor.

C. Mixer Construction:
1. Mixer, case:
   a. Mixer motor housing: Gray cast iron ASTM A-48, Class 30 inner stator base with outer 316 stainless steel jacket.
   b. Seals: External mating parts machined and sealed with a nitrile rubber O-ring on a beveled edge.
   c. Exposed fasteners: 300 series stainless steel.
2. Mixer shaft: 420 series stainless steel.
3. Bearings:
   a. Roller and angular contact bearings with a rated minimum B10 life of 100,000 hours.
4. Mechanical seal:
   a. Number of seals: Two.

b. Type: Mechanical with tungsten carbide rotating seal faces and tungsten carbide stationary seal faces.
c. Mounting: Tandem with an oil chamber between seals.
d. Lubrication: Oil bath.

5. Propeller:
   a. Construction material: 316 stainless steel.
   b. Type: Three-vane with jet ring.
   c. Balancing: Dynamically balanced.
   d. Non-clogging backward curve design.
   e. Provide a 316 stainless steel propeller jet ring.
6. Mixer connection to mast.
   a. Construction: 316 stainless steel.
7. Lifting and support cable: Stainless steel.
8. Mounting brackets: 316 stainless steel, minimum 3 required.
9. Sliding brackets: 316 stainless steel.

2.5 MAST

A. Manufacturer's floor mounted mixer support and removal system, stainless steel.

2.6 ACCESSORIES

A. Spare Parts:
   1. Gaskets and O-ring seals: Three complete sets.
   2. Mechanical seal: Three complete sets.

2.7 FINISHING

A. Shop and Field Painting:
   1. Verify compatibility of shop prime and field paint.
   2. Finish all non-stainless steel and reinforced fiberglass surfaces.

2.8 INSTRUMENTATION AND CONTROL

A. Mixer 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 mixer, indicate mixer fail alarm, and activate the remote common fail.
   2. Heat Sensors: Provide heat sensors in mixer motor.
      a. Upon the heat sensors sensing a high temperature in the motor stator, the controls shall shut down the mixer, indicate mixer fail alarm, and activate the remote common fail. Automatically reset when temperature returns to normal.
   3. High temperature and moisture protection such as Flygt MINI CAS relay to be installed in existing main control panel CP-500. Overtemperature and Moisture indication to be displayed seperately on relay. Moisture to require manual reset. Overtemperature to automatically reset. Provide panel mounting for relay.

4. Mixer motor starter, circuit breaker, HOA selector switch, Run/Fail LED indicators, reset button to be located in new MCC-1A. See drawings and Section 16443.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with Drawings, shop drawings, and manufacturer's instructions.

3.2 MANUFACTURER'S SERVICES

A. Minimum service requirements:
   1. Installation: As required for proper installation.
   2. Start-up and field testing: One full day on site.
   3. Operator training: One day on site, separate from start-up and field testing
      a. Training shall include normal operations, starting procedures, shut-down, and routine maintenance procedures
   4. Training shall be provided by experienced and qualified personnel employed by the equipment manufacturer or supplier.

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.

B. Furnish, install, engineer, wire, adjust, calibrate, test, start-up, commission, and train operations personnel for field instrumentation and control devices as listed below.

1.2 SUBMITTALS

A. Submittals shall be as specified in the following specification sections:
   1. Division 1.

PART 2 PRODUCT

2.1 FLOAT SWITCHES

A. General Specifications
   1. The float switches shall be of the normally open or normally closed 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. Consolidated Electric Company (Model 9G).
   2. Anchor Scientific (Rotofloat SST).
   3. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
LSH 1-1/LSL-1-1	EQ Tank	90-I-1

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 EQ tank float switches shall be mounted. See

mechanical installation drawings for determining type to be applied to application.

3. Float switches 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 float switch manufacturer.
4. All hardware shall be stainless steel including bracket anchors.

2.2 REMOTE SELECTOR SWITCHES

A. General Specifications
1. Three or two position maintained position type selector switch.
2. 30.5mm type. Industrial grade, heavy duty, watertight, oil tight types. They shall be rated NEMA 4, 4X and 13, corrosion resistant. In explosion hazard areas they shall be rated NEMA 7.
3. Provide 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.
4. 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.

B. Acceptable Manufacturer
1. Square D Class 9001.
2. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	TYPE	P & ID
NOT USED			

D. 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 7.
3. Install per manufacturer’s instructions.

2.2 MAGNETIC FLOW METER

A. General Specifications
1. 2 Year Warranty.
2. Specific design for waste water industry.
3. Operating Principle: Faraday's Law.
4. Excitation Type: bipolar pulsed DC.
5. System Accuracy: Plus or minus 0.05% 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.
6. Each system shall be factory calibrated before shipment. No realignment shall be necessary.
7. Wastewater Operating Temperature 14 to +140 degrees F.
8. Hot Water Operating Temperature 0 to 250 degrees F.
9. Power: 120 Volts AC, 60 Hz (Provide with surge protection).

B. Primary Element - Meter
   1. NEMA 4X Enclosure.
   2. Integral Earthing Grounding electrodes or provide grounding rings, orifices, and electrodes as necessary.
   3. Flange Mounting.
   4. At a minimum, the primary element shall be approved for installation in Class 1, Division II, Group A through G Hazardous Locations. Also, primary element shall be suitable for Class 1 Division I, Group A through G Hazardous Locations where shown as classified on the drawings and/or shown in Equipment Data below.
   5. 316 Stainless Steel Electrodes.
   6. PTFE meter liner.

C. Transmitter
   1. NEMA 4X Enclosure and rated for outdoor operation.
   2. Integral or Separate Mounting as shown on the drawings and/or shown in Equipment Data below.
   3. Micro-processor based, capable of bi-directional flow, field configurable without any external device.
   4. Integral self diagnostics.
   5. Auto integrated zeroing.
   6. Local display shall indicate flow rate and total.
   7. Memory type: Non-volatile.
   8. 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.
   9. Isolated powered 4-20 mA output.
   10. Pulsed output for totalization.

D. Acceptable Manufacturer
   1. Rosemount.
   2. Endress+Hauser.
   3. Siemens.
   4. Or Approved Equal.

E. Equipment Data

TAG NO	PROCESS	SIZE	NOTES	P & ID
NOT USED				

F. 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. 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.
   3. The system shall be installed, wired, and calibrated in strict compliance with the manufacturer's instructions.
   4. Calibrate each flowmeter as follows:

a. 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.

5. Provide a written loop-calibration report for each flowmeter, which shall include, but shall not be limited to, the following:
   a. Date and time the final calibration was complete.
   b. Comparison of readings at the flowmeter with all other remote readings.
   c. The names and signatures of personnel performing the calibration.

2.3 RADAR LEVEL SENSOR/TRANSMITTER

A. General Specifications
1. 25 to 26Ghz Microwave Pulse Radar Technology
2. FCC approved
3. Measure and locally display level in engineering units in separate unit mounted on wall or handrail adjacent to probe. Provide all required cabling between probe and display unit. (Display Units are tagged LIT).
4. Display unit shall have local LCD display, system-programming capability and be specifically designed for Wastewater Treatment Plant application.
5. Probe head to be constructed of corrosion resistant and weather proof materials. If noted on plan, unit shall be rated for operation in Class1, Division 1, Group C, D Environments or Intrinsic Safe equivalent. (Provide intrinsic safe barriers if required.).
6. Provide 4" horn antenna with probe and all required mounting hardware for a wet well application.
7. Probe to be complete with integral temperature compensation and all required mounting hardware and accessories.
8. 4-wire (120 VAC, 60 Hz) technology with 4-20mA output signal proportional to level.
9. System accuracy +/- 3mm.
10. System shall be designed for outdoor operation and shall function with ambient temperatures of -30 to 150 degrees F.
11. Complete with HART field communication interface.

B. Acceptable Manufacturer
1. VEGA Grieshaber KG
2. Rosemount
3. Yokagawa
4. Krohne

C. Equipment Data

TAG NO	PROCESS	MOUNTING	P & ID
LE-1-1	EQ Tank Level	Top Entry	90-I-1
LIT-1-1	EQ Tank Level	Tank Platform	90-I-1

D. Installation Notes
1. Install per manufacturer's instructions and in accordance with installation detail.
2. Calibrate each Level Transmitter as follows:

a. 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.

3. Provide a written loop-calibration report for each level transmitter, which shall include, but shall not be limited to, the following:
   a. Date and time the final calibration was complete.
   b. Comparison of readings at the level transmitter with all other remote readings.
   c. The names and signatures of personnel performing the calibration.

2.4 ULTRASONIC FLOW AND LEVEL SENSOR\TRANSMITTER

A. General Specifications
1. The hydrostatic level is sensed by an ultrasonic transducer.
2. Flume flow is sensed by level measured on flume inlet and transmitter converts level to flow output signal.
3. Separate sensor mounted in tank or basin being monitored.
4. 2 Year Warranty.

B. Sensor
1. 2" Male NPT process mount.
2. Process interface material PVDF.
3. Intrinsic safe or explosion proof for use in Class 1, Division 1, Group C&D area.

C. Transmitter
1. Accuracy: Plus or minus 0.25 percent of span.
2. All ultrasonic transmitters shall be same manufacturer.
3. Temperature Limits: -4 to 140 degrees F.
4. Transmitter to have digital display calibrated to engineering units. Transmitter enclosure shall be rated NEMA 4X.
5. ½" conduit connection.
6. 4-20 mA Isolated Level Transmitter output.
7. Display 4 digit, LCD.
8. Button Programmable.
9. Maximum deadband: 6".
10. 8 degree conical.
11. Range 6 inch to 18 ft.

D. Acceptable Manufacturer
1. Endress+Hauser.
2. Miltronics.
3. Or Approved Equal.

E. Equipment Data

TAG NO	PROCESS	TRANSMITTER	P & ID
NOT USED			

F. Installation Notes
1. Install per manufacturer's instructions and in accordance with installation detail.
2. Calibrate each Level Transmitter as follows:

a. 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.

3. Provide a written loop-calibration report for each level transmitter, which shall include, but shall not be limited to, the following:
   a. Date and time the final calibration was complete.
   b. Comparison of readings at the level transmitter with all other remote readings.
   c. The names and signatures of personnel performing the calibration.

2.5 GAS SENSOR\TRANSMITTER

A. General Specifications
1. NEMA 4X and 7 explosion proof conduit style enclosure for sensor and transmitter integral in one enclosure.
2. Provide 0-100% LEL Combustible Gas Sensor/Transmitters as shown on drawings.
3. Provide 0-21% Oxygen Sensor/Transmitters as shown on drawings.
4. Provide 0-20 ppm Hydrogen Sulfide Sensor/Transmitters as shown on drawings.
5. Sensors and Transmitters shall be manufactured by the same company.
6. LCD Display on each transmitter.
7. Alarm 1, Alarm 2 and Fault outputs from each sensor.
8. 316SS construction, Explosion Proof Rated. UL/CSA tested.
9. Two year warranty.

B. Acceptable Manufacturer
1. Sieger-APEX (Honeywell).
2. MSA.
3. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

D. Installation Notes
1. All mounting hardware shall be stainless steel or other non-corrosive material.
2. Install per manufacturer's instructions.

2.6 REMOTE E-STOP SWITCH

A. General Specifications
1. Single maintained position pushbutton.
2. 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.
3. Provide 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.
4. LED illuminated red mushroom type.
5. 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.

B. Acceptable Manufacturer
1. Square D Class 9001.
2. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

D. 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 manufacturer's instructions.

2.7 AIR AND GAS FLOW TRANSMITTERS

A. General Specifications
1. Thermal Mass Flowmeter for Gas or Air Application. Thermal Dispersion technology.
2. Microprocessor based transmitter design.
3. Transmitter and Sensor to be integral in one package.
4. Sensor and Transmitter to be mounted directly on piping.
5. Operating Temperature to be -25 to 140 degrees for units mounted outside. Operating Temperature to be 0 to 140 degrees for units mounted inside.
6. Temperature compensation to be +/-100 degrees F.
7. Accuracy to be +/- 1% of reading + 0.5% of full scale.
8. NEMA 4X enclosure for units measuring air flow. NEMA 4X and Explosion Proof (NEMA 7) for units measuring gas flow.
9. Insertion flow element to be provided with a 3/4 inch NPT male stainless steel process connection and compression fitting to allow transmitter maintenance. Insertion lengths to be determined by manufacturer.
10. Transmitter to by powered by 120Vac.
11. Transmitter to provide 4 to 20mA into 600 ohms and be isolated from 120Vac.
12. 1 year warranty.

B. Acceptable Manufacturer
1. Fluid Components International (FCI) - ST98.
2. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	NOTES	SHEET
NOT USED			

D. Installation Notes
1. All mounting hardware shall be stainless steel or other non-corrosive material.

2. Install per manufacturer's instructions and in accordance with manufacturer's installation details.
3. Each system, including its complete instrument loop, shall be calibrated by a manufacturer's representative. All remote readings shall be equal to reading at the converter indicator and main control system displays.
4. Provide all electrical connections and components.
5. Installation and commissioning shall be by factory trained representative.
6. Provide a written loop-calibration report for each transmitter, which shall include, but shall not be limited to, the following:
   a. Date and time the final calibration was complete.
   b. Comparison of readings at the transmitter with all other remote readings.
   c. The names and signatures of personnel performing the calibration.

2.8 PRESSURE TRANSMITTER

A. General Specifications
1. Provide transmitters to measure pipe pressure.
2. Provide with integral readout in engineering units.
3. Adjustable span 0-150 PSI.
4. +/- 0.1% accuracy.
5. All wetted parts to be stainless steel.
6. Process connection for pressure ½ Inch NPT.
7. Process connection for level 4" Flange Mount Connection.
8. Provide all required mounting hardware.
9. Provide all required process connection piping including isolation valve.
10. 2-wire 4-20mA type.
11. 1 year warranty.

B. Acceptable Manufacturer
1. Endress+Hauser.
2. Foxboro.
3. Honeywell.
4. Rosemount.
5. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

D. Installation Notes
1. All mounting hardware shall be stainless steel or other non-corrosive material.
2. Install per manufacturer's instructions and in accordance with manufacturer's installation details.
3. Each system, including its complete instrument loop, shall be calibrated by a manufacturer's representative. All remote readings shall be equal to reading at the converter indicator and main control system displays.
4. Provide all electrical connections and components.
5. Provide a written loop-calibration report for each switch, which shall include, but shall not be limited to, the following:

a. Date and time the final calibration was complete.
b. Comparison of readings at the transmitter with all other remote readings. The names and signatures of personnel performing the calibration.

2.9 TEMPERATURE INDICATING TRANSMITTER

A. General Specifications
1. Resistance temperature detector (RTD) probe, imbedded in a sheath, provided with integral two-wire transmitter and digital indicator.
2. RTD probe shall be dual, three-wire, 100 Ohm, Platinum type. The first RTD shall be connected to the transmitter. The second shall be spare.
3. Alpha: .00385 Ohm/Ohm/Degree Celsius.
4. Sheath Material: 316 Stainless Steel.
5. Sheath shall be provided with compression spring.
6. Sheath length: As required per well dimension and installation.
7. Insertion Length and Diameter: As required per mechanical drawings.

B. Transmitter
1. Input: 3-wire Platinum RTD.
2. Output: 4 to 20 mA DC, linear to process temperature.
3. Accuracy: Plus or minus 0.1% of span at reference conditions.
4. Ambient Temperature Effect: 0.01% of span per degree Celsius change in ambient temperature, maximum.
5. Adjustability:
   a. Zero: Plus or minus 10 degrees Celsius from nominal zero.
   b. Span: Plus or minus 10% of the original nominal span.
6. Ambient Temperature Limits: -40 to 85 degrees Celsius.
7. Power Supply: 12 to 40 Volts DC, external.
8. Power Protection: Reverse polarity diode.
9. Linearity: Plus or minus 0.05% of span.
10. Response Time: Less than 0.01 seconds.
11. Warm Up Time: Less than 30 seconds to within 0.04 Ohms.
12. Housing: NEMA 4X, 7 & 9.
13. UL approved for Class 1, Division 1, Groups C & D.
14. Temperature Range: 50 to 200 degrees Fahrenheit Probe: 316 Stainless Steel.

C. Acceptable Manufacturer
1. Sensor Tec.
2. Or Approved Equal.

D. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

E. Installation Notes
1. Coordinate transmitter thermowells and obtain thermowell dimensions prior to ordering.
2. Install per manufacturer's instructions and in accordance with the details.
3. Each system, including its complete instrument loop, shall be calibrated by a manufacturer's representative. All remote readings shall be equal to reading at the converter indicator and main control system displays.
4. Provide a written loop-calibration report for each transmitter, which shall include, but shall not be limited to, the following:
a. Date and time the final calibration was complete.
b. Comparison of readings at the transmitter with all other remote readings.
c. The names and signatures of personnel performing the calibration.

2.10 pH SENSOR AND INDICATING TRANSMITTER

A. General Specifications
1. Measure and locally display pH in engineering units.
2. Transmitter shall have a 4-20mA output, with parameters available to adjust scale.
3. Transmitter shall be able to accept pH sensors.
4. Sensor and transmitter to be compatible models by the same manufacturer.
5. Sensor function (pH) shall be as indicated on P&IDs.
6. Built in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity and shall have temperature compensation.
7. Provide optional sensor protector of the same material as the sensor.
8. Provide all required mounting hardware.
9. Provide all required process connection piping including isolation valve.

B. Acceptable Manufacturer
1. GLI International.

C. Equipment Data

TAG NO.	PROCESS	P & ID
AE/AIT-1-1	EQ Tank	90-I-1

D. Installation Notes
1. Install per manufacturers recommendations.

2.11 PRESSURE SWITCHES AND SEALS FOR PROCESS SYSTEMS

A. General Specifications
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 Switches
1. Manufacturer:

a. SOR, Series RN.
b. Or Approved Equal.

2. Enclosure: NEMA 4X, unless otherwise noted.
3. Switch Function: Single point adjustable deadband, SPDT contact, minimum 15 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.

C. Diaphragm Seals

1. Manufacturer:
   a. Ashcroft Series 100.
   b. Or Approved 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.

D. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

E. Installation Notes

1. Install per manufacturers recommendations.

2.12 CAPACITIVE LEVEL SWITCH

A. General Specifications

1. The level switch shall be constructed of 316 stainless steel, or approved non-corrosive material.
2. Manufacturer to calibrate to Owner specified settings, with parameters available to adjust scale.
3. Sensor and switch to be compatible models by the same manufacturer.
4. Sensor function shall be as indicated on P&IDs.
5. Built in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity.
6. Provide optional sensor protector (if available) of the same material as the sensor.
7. Provide all required mounting hardware.

B. Acceptable Manufacturer

1. Drexelbrook.
2. Endress-Hauser.
3. Gems.
4. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

D. Installation Notes
   1. Install per manufacturers recommendations.

2.13 INDUCTIVE SENSOR

A. General Specifications
   1. The inductive sensor shall be constructed of 316 stainless steel, or approved non-corrosive material.
   2. Sensor function shall be as indicated on P&IDs.
   3. Built in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity.
   4. Provide all required mounting hardware.

B. Acceptable Manufacturer
   1. Ifm Electronic.
   2. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	P & ID
NOT USED		

D. Installation Notes
   1. Install per manufacturers recommendations.

2.14 CAPACITIVE CONTACT

A. General Specifications
   1. The contact housing shall be constructed of 316 stainless steel, or approved non-corrosive material.
   2. Cover seal: Silicon coated with PTFE.
   3. Sensor function shall be as indicated on P&IDs.
   4. Built in electronics of the sensor shall be completely encapsulated for protection from moisture and humidity.
   5. Sealing ring for process connection: Elastomer fiber, asbestos-free, resistant to lubricants, solvents, steam, weak acids and alkalis.
   6. Probe insulation: PTFE.
   7. Provide all required mounting hardware.

B. Acceptable Manufacturer
   1. Endress-Hauser.
   2. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	SHEET
NOT USED		

D. Installation Notes
1. Install per manufacturers recommendations.

2.15 THERMAL FLUID FLOW SWITCHES

A. General Specifications
1. The flow switches shall be of the normally open or normally closed thermal mass type switch rated for high temperature.
2. Transmitter and sensor to be integral in one package.
3. NEMA 4X enclosure.
4. The flow switch transmitter shall be mounted remotely from the element.
5. The flow switches shall be constructed of 316 stainless steel.
6. Insertion flow switch shall be provided with a ¾ inch NPT male class 300 carbon steel process connections and compression fitting to allow transmitter maintenance, to be compatible with 11370-A thermal fluid piping. Insertion lengths to be determined by manufacturer.
7. Ambient temperature: -40 to 104 deg F.
8. Process fluid: Paratherm HE thermal fluid.
9. Process operating temperature: 300 to 450 deg F.
10. Process operating pressure: 150 psig.
11. Design velocity: 5.5 fps.
12. Adjustable velocity range: 0.01 to 10 fps.
13. Repeatability: +/- 1% of setpoint.
14. Response time: 0.5 to 10 seconds.
15. Power: 120 Volts AC, 60Hz.
16. Each flow switch shall be provided with all required mounting hardware as specified in the "INSTALLATION NOTES" section of this form.
17. 1 year warranty.

B. Acceptable Manufacturer
1. Fluid Components International (FCI).
2. Sierra Instruments.
3. Or Approved Equal.

C. Equipment Data

TAG NO.	PROCESS	NOTES	P & ID
NOT USED			

D. Installation Notes
1. Install per manufacturer's instructions and in accordance with installation detail.
2. All hardware shall be stainless steel including bracket anchors.
3. Each system, including its complete instrument loop, shall be calibrated by a manufacturer's representative.
4. Provide all electrical connections and components.
5. Installation and commissioning shall be by a factory trained representative.
6. Provide a written loop-calibration report for each transmitter, which shall include, but shall not be limited to the following:
   a. Date and time the final calibration was complete.
   b. Comparison of readings at the transmitter with all other remote readings.

c. 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. Lengths shall be confirmed during construction.

END OF SECTION

SECTION 13420

BOLTED STEEL TANKS

1. PART 1 GENERAL

1.1. SECTION INCLUDES

A. Bolted steel tanks:
   1. Influent Equalization Tank.

B. Major Components include but are not limited to:
   1. Bolted Steel Tank
   2. Tank Cover
   3. Appurtenances
   4. Access Ladder and Platform

1.2. SYSTEM DESCRIPTION

A. The influent equalization tank consists of a bolted steel tank of 189,000 gallon capacity (nominal) with sloped roof without interior support columns. It is equipped with one submersible mixer to mix the contents of the tank.

1.3. REFERENCES

A. AWWA D103 - Standard for Factory-Coated Bolted Steel Tanks for Water Storage.

1.4. DESIGN REQUIREMENTS

A. EQUALIZATION TANK GENERAL REQUIREMENTS
   1. Suitable for outdoor storage of wastewater from a dairy processing facility in north central Georgia.
   2. Wastewater temperature range, degrees Fahrenheit: 60 to 130.
   3. pH, s.u.: 5 to 12.
   4. Pressure: Ambient.
   5. Nominal Maximum Capacity, gallons: 189,000.
   6. Maximum liquid level, feet: 30.0 at the sidewall
   7. Sidewall height, feet: 31.5 (use manufacturer's standard dimensions).
   8. Tank Diameter: 33'-0" (use manufacturer's standard dimensions).
   9. Foundation: Concrete ringwall with embedded setting ring and concrete floor.
   10. Side wall fittings:
      a. Drain nozzle: one 6-inch, single
      b. Inlet nozzle, wastewater: one 8-inch, double

c. Outlet nozzle, wastewater: one 8-inch, single.
d. pH probe: one 4-inch, 45 degree up, blind flange.
e. Manway: one 24-inch diameter.
f. Spare nozzles: two 2-inch, single, blind flange.

11. Roof deck fittings:
a. Odorous air: one 4-inch, single.
b. Vent: one center of roof dome with screen ventilator.
c. Radar level sensor mount: one 6-inch, single (confirm size with level sensor supplier).
d. Access hatch: One 24-inch square hinged manway with stainless steel bracket for two float switches.
e. Mixer accessway: one 36-inch by 48-inch (confirm size with mixer supplier). Dual hinge, open from middle (Bilco or equal).
f. Spare: one 4-inch, single, blind flange.

12. Provide stainless steel (5/8" dia.) bottom studs for mixer masts (verify size and requirements with mixer supplier).

13. Provide galvanized outside ladder with cage and mixer access platform. Also provide galvanized handrail along perimeter of tank cover and around mixer access platform. Removable handrail on tank-facing side of platform.

B. Tanks and covers to withstand deadload, dynamic load, wind load, design loads, and applicable snow load in accordance with the latest version of all applicable local and state codes.

C. Provide adequate tank reinforcing to support the mixer mounting system and mixer dynamic loads at top and sidewall (intermediate supports). Coordinate with the mixer supplier.

1.5. SUBMITTALS

A. BID SUBMITTALS: Submit four (4) complete sets of bid information that include the following:
1. Cost of equipment and work specified herein. Include FOB to jobsite (Dacula, Georgia) and erection on Contractor-provided foundation.
2. Provide delivery time from date of order receipt for embedded base setting ring and for remainder of tank.
3. Provide time for drawing preparation and review by Owner/Engineer.
4. Provide descriptive information on material and components furnished.
5. Provide references on similar installations.
6. Submit standard and available color samples.

B. SHOP DRAWINGS: Submit minimum of four (4) complete sets of shop drawings for review in accordance with Division 1. Three (3) sets will be retained by Owner. One reviewed set will be returned to the supplier for fabrication. The shop drawings shall include the following:

1. Complete assembly and installation drawings of the tank, cover, ladder, and top platform.
2. Descriptive information on material and components furnished.
3. Manufacturers installation instructions: Indicate preparation requirements and assembly sequence.

C. AS-BUILT DRAWINGS: Submit four (4) complete sets of corrected shop drawings that reflect as-built conditions.

1.6. QUALITY ASSURANCE

A. Type and quality of workmanship shall conform to AWWA standards.

B. Repairs for minor damage, scratches, and abrasions may be made where permitted by the Owner/Engineer, in a manner recommended by the manufacturer.

C. Units damaged beyond repair in the opinion of the Owner/Engineer will be rejected and replaced with undamaged units.

1.7. REGULATORY REQUIREMENTS

A. Conform to the Requirements of all applicable local, state, and federal regulations.

B. Cooperate with regulatory agencies or authorities and provide data as required.

1.8. WARRANTY

A. Provide a one-year warranty on materials and labor after installation.

B. If found defective, Manufacturer shall promptly, without cost to Owner and in accordance with Owner's written instructions: repair or replace equipment, and satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or areas resulting therefrom.

C. If Manufacturer does not promptly comply with the terms of instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective equipment repaired or replaced, and 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 the Manufacturer.

2. PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Columbian TecTank Company, Kansas City, Kansas.

B. Tank Connection, Rogers, Arkansas.

C. Or approved equal.

2.2. MATERIAL

A. Plates and sheets used in construction of the tank shell: Conform to ASTM A570 Grade 33 and AWWA D103, Section 2.4.

B. Rolled structural shapes: Conform to ASTM A36 and AWWA D103, Section 2.5.

C. Bolts, Nuts, and Washers: Minimum ½" dia., conform to AWWA D103. Galvanized bolts, nuts, and washer shall meet the requirements of API 12B, Appendix A, except that bolt heads may be other than square. Polycapped bolt heads shall be used for additional corrosion protection. Other bolts shall conform to the latest revision of ASTM A307.

D. Sealant: Air cured flexible, conforming to FS TT-S-00230 Type II non-sag, I-self leveling, Class A; Vulkem 116 manufactured by Mameco International; or approved equal. Must be suitable for dairy processing wastes including CIP.

2.3. FINISH

A. Factory coat metal plates, sheet members, and miscellaneous parts, except bolts, in accordance with the provisions of these specifications. Must be suitable for dairy processing wastes including CIP.

B. Field coating, except for touch-up, will not be permitted.

C. Surface Preparation
1. Tank parts are to be thoroughly washed and rinsed to remove grease, oil and foreign matter.
2. Parts are then to be immediately oven dried.
3. Parts are to be grit-blasted to SSPC-SP 10 (near-white blast cleaning) to 2-3 mils profile.
4. All parts must be coated within 15 minutes after blasting, and no further processing other than coating application shall be done.

D. Interior Coating
1. Thermally cured modified epoxy powder, Trico-Bond SD by Columbian TecTank, LIQ Fusion 7000 FBE by Tank Connection, or equal.

2. First coat is to be a powder application of NSF approved modified epoxy, 2.5 mils average dry film thickness.
3. Second coat is to be a powder application of NSF approved modified epoxy, 2.5 mils average dry film thickness.
4. Coating system to have 5.0 mils minimum dry film thickness.

E. Exterior Coating.
1. Thermally cured modified epoxy powder with performance topcoat. Trico-Bond EP and acrylic polyurethane by Columbian TecTank, EXT Fusion 5000 FBE and EXT Fusion SDP by Tank Connection, or equal.
2. First coat is to be a powder application of modified epoxy, 2.5 mils minimum dry film thickness.
3. Second coat of performance topcoat, 1.5 mils minimum dry film thickness.

F. Curing
1. Baking ovens to be used after each coat.
2. Final coat is to be cured in the baking oven for at least 15 minutes.

G. Preparation for transport
1. Material to be marked or tagged with part number for ease of field assembly.
2. Tank materials to be placed in racks or on pallets to facilitate transport to jobsite.
3. Touch-up paint with instructions for application by erection personnel.

H. Inspection
1. Visually inspect for defects, holidays, and color.
2. Film thickness: Factory test for mil thickness using Nordson Dry Film Thickness Gauge or equivalent magnetic gauge.
3. Microscopic defects: Factory test for microscopic defects with wet-pad resistance test.
4. Field test completely assembled tank for defects and damage from construction using wet-pad resistance test.

2.4. APPURTENANCES

A. Unless otherwise noted, furnish in accordance with AWWA D103, Section 5.

B. Inlet and Outlet Connections.
1. Conform to sizes specified.
2. Type: Flange bolted.
3. Flanged connections: Conform to ANSI 150 lb flange specifications.

C. Side Manway
1. Size and quantity: As listed in the design requirements in this specification.

2. Material: Steel.
3. Type: Gasketed flat plate hatch bolted to tank.

D. Tank Platforms and Access Ladders
1. Construction: Galvanized steel in accordance with ASTM A123 and ASTM A153.
2. Fasteners: Series 300 stainless steel.
3. Platform Size: 4'-0" by 5'-0" minimum on side of tank and along the mixer accessway.
4. Platform Material: galvanized steel.
5. Provide a ladder and cage to access the platform from grade (elevation of top of tank floor).
6. Provide handrails and toe plates per OSHA requirements.
7. Special Features.
   a. Provide for mounting of one hoist to each deck.
   b. Hoist location: as shown in the Drawings.
   c. Hoist mounting plate: 3/4" thick, 19" by 19" steel plate with 1/4" by 3" stiffeners crossing the plate's center line.
   d. Hoist loadings:
      1) live load: 1,000 lbs.
      2) live moment: 4,000 ft-lbs.
      3) dead load: 200 lbs.

E. Overflow
1. Not required.

F. Cover hatches and vents
1. Provide access hatches and vents of manufacturer's standard design.
2. Sizes, locations, and quantity: As listed in the design requirements in this specification.
4. Fabricate access hatches with hinged doors, lifting handles, door hold open arms, and piano-type hinges.
5. Provide all hardware in stainless steel construction.
6. Coordinate the hatch's size and construction with the mixer manufacturer to allow simple installation and removal of the mixer through the hatch.
7. The vent shall be of a sufficient size to accommodate normal inlet and outlet flow and be designed to prevent the entrance of birds, animals, or insects.

2.5. CORROSION PROTECTION:

A. Type: Passive sacrificial anode protection system, as required by manufacturer.

B. Continuity: Tank supplier to use positive means to achieve permanent continuity between tank members. The manufacturer shall perform field testing to demonstrate continuity of the tank to the Owner/Engineer. The Owner/Engineer shall be notified 24 hours before testing.

3. PART 3 EXECUTION

3.1. ERECTION

A. Erect tanks specified herein in accordance with manufacturer's written instruction.

B. Erect tanks on Contractor-supplied foundation. Provide embedded materials and assist in its proper installation.

C. Exercise particular care in handling and bolting tank plates and members to avoid abrasion and scratching of the coating system.

D. Seal joints between plates with sealant in accordance with the sealant manufacturer's recommendations for surface preparation, temperature, environmental conditions, and miscellaneous requirements.

E. Maximum variations from plumb: 1/4 inch in 10 feet, ½ inch for full height of tank.

3.2. TESTING

A. After completion of field installation, fill tanks with water to within 24 inches of the top and allow to stand full for a period of not less than 48 hours.

B. Repair leaks or indications of leaks in tanks or accessory connections.

C. Retest to satisfaction of Engineer.

D. Owner to provide and dispose of test water.

3.3. MANUFACTURER'S FIELD SERVICES

A. Assist Contractor in setting embedded setting ring, anchors and/or base plates.

B. Provide manufacturer's certificate of proper installation.

C. Minimum Service Requirements:
   1. Installation: Inspection as required for proper installation.
   2. Start-up and field testing: As required for testing.
   3. Operator training: One-half day on site, separate from installation and start-up and field testing.

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 138; 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 62; 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 128W as manufactured by Dresser Industries, Inc.; or equal
         2) Steel pipe: provide Series 913 as manufactured by Smith-Blair, Inc.; or Style 128W 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, Anvil International 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, Anvil International 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, Anvil International 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: Joints between dissimilar buried pipe shall be made 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.

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.

E. Rupture Disks: Rupture disks shall be made of impervious graphite, inverted type, with a 150 psi rupture pressure. Install rupture disks between ANSI 150 lb flanges, as shown on the Contract Drawings. Manufactured by Fike, Zook, or BS&B.

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

Pipe Size	Maximum Support Hanger Span	Minimum Rod Size Single Rod Hangers
1-1/4-inch thru 2-1/2-inch	8 feet	3/8-inch
3-inch and 4-inch	10 feet	1/2-inch
6-inch	12 feet	5/8-inch
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 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 all be 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 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.

B. Submit operations and maintenance manual under the provisions of Section 01730.

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. Valve manufacturer standard box, if applicable, may be substituted with Engineer approval.

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 Type 304 stainless steel valve extension stems for submerged extension stem installations.

E. 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 CWP, and shall be Milwaukee Valve Company Figure 1140; NIBCO Figure T-133; or equal.

B. V101: Gate valves 2-1/2 inches and larger for steam service shall be iron body, bronze mounted valves with flanged ends, solid wedge gate, and non-rising bronze stem. Valves shall be rated 250 psi SWP, 500 psi CWP, and rated for continuous steam service at 370°F. Valves shall be Crane Figure 3E, Milwaukee Valve Company Figure F-2894A, NIBCO Figure F-669; or equal.

C. 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.

D. 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 Control Series 2500; American R/D Gate Valve Co. Series 2000; no substitutions.

E. 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.

F. 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.

G. 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.

H. V150: Knife gate valves 18 through 30 inches shall be bonnetless wafer body type with outside stem and yoke, rated for 150 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. The gate edge shall be radiused and have a 45 degree edge. The

packing system shall fit a machined packing chamber. Packing system shall be multiple layers of flax, or combinations thereof, to provide a leak-tight seal around the gate. The packing gland shall be 316 stainless steel. 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 DeZurik Series KGC, Orbinox Series 20, Fabri-Valve Figure 37; Josam-Wey Valve Manufacturing Co. Model A1; Rovalve Figure 17; or equal.

I. V151: Knife gate valves 2 through 30 inches shall be bonnetless wafer body type with outside stem and yoke, rated for 150 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. The gate edge shall be radiused and have a 45 degree knife edge. The packing system shall fit a machined packing chamber. Packing system shall be multiple layers of flax, or combinations thereof, to provide a leak-tight seal around the gate. The packing gland shall be 316 stainless steel. 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, two piece with screwed ends, full port, Teflon seats, and hand lever operators, rated 150 SWP, 600 CWP. Valves shall be Apollo 70-100; NIBCO Figure T-585-70; Stockham Figure No. T-285; or equal.

B. V301: Ball valves 2 inches and smaller, for steam service, shall be bronze, end entry type, two piece with screwed ends, standard bore ports, Teflon seats, and hand lever operators, rated 250 psi SWP, 600 psi CWP, and rated for continuous steam service at 370°F. Valves shall be Apollo 70-140; NIBCO Figure T-585-70-66-ST; Milwaukee BA-400S3, or equal.

C. 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.

D. 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; NIBCO T-580-S6-R-66; Stockham Fig. No. S-206-SSMO-R-T; or equal.

E. 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.

F. 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., Woodland Hills, CA; Spears Manufacturing, Sylmar, CA, or equal.

G. 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., Woodland Hills, CA; Spears Manufacturing, Sylmar, CA, or equal.

H. 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; 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 3 inches and smaller and manual gear operators for valves 4 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 (mechanical joint ends for buried service), balanced ductile iron 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 body with flanged ends, cast iron balanced plug with hycar or neoprene elastomer, Buna-Vee packing or O-ring seals 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; 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 shall have a copper inlet and inside IP outlet and shall be Mueller H-15185, or equal.

F. V421: Corporation stops for 3/4-inch through 1-1/2-inch services shall have AWWA thread inlet and a compressive connection for a copper pipe outlet and shall be Mueller H-15000, Hays Manufacturing Company 5200, or equal. Corporation stops for 2-inch services shall have outside iron pipe thread inlet and a compression connection for a copper pipe outlet and shall be Hays Manufacturing Company 5204, Mueller H-15025, or equal.

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: Natural 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.

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 service, non-lubricated, eccentric type rectangular port with minimum 80% port area, 1/2 inches through 12 inches, shall have nitrile-butadiene resilient faced 316 stainless steel plugs and shall be furnished with flanged end connections. Wrench lever manual operators shall be provided for valves 3 inches and less in size, and manual gear operators shall be provided for valves 4 inches and larger. Valve bodies shall be of ASTM A126 Class B cast iron compliance with AWWA C504 Section 2.2. 3” and larger bodies shall be furnished 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 U-ring style for valves 3 inches or less, and of the multiple V-ring type for valves 4 inches and larger. Shaft seals 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, Val-Matic, 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 Lunkeheimer 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 Series 100, Figure 118F; 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 (BOS-US); 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; valves for ferric chloride service shall have EPDM seats and O-ring stem. 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., Woodland Hills, CA; Spears Manufacturing, Sylmar, 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. 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.

H. Telescoping Valves:
   1. Manufacturer:
      a. Hydro Gate Corporation.
      b. Latanick Equipment Inc.
      c. Or equal.
   2. General: The telescoping valve shall consist of a sliding tube, packing flange, packing, and operating mechanism.
   3. Valve Size: As shown on the Drawings.
   4. Vertical travel (ft): As shown on the Drawings.
   5. Sliding Tube: The sliding tube shall be made of 316 or 304 fabricated stainless steel and shall have a square end. The tube shall have a smooth finish on the entire surface that comes in contact with the packing ring. A fabricated 316 or 304 stainless steel bail shall be attached to the top of the tube for connections to the operating mechanism.
   6. Packing: The packing flange shall be 316 or 304 stainless steel and through drilled to ANSI 125 pound standard. It shall be machined to receive a neoprene gasket.
   7. Operating Mechanism: The operator mechanism shall consist of a cast iron straight floor stand, a hand wheel capable of setting the valve in any position along the specified travel, two (2) adjustable 316 or 304 stainless steel stop collars to prevent over-travel, and a stainless steel type 316 or 304 extension stem. All telescoping valve operators shall be provided with a graduated clear plastic stem cover with rain cap to show the position of the valve in tenths of an inch.
   8. Telescoping Valves: Telescoping valves shall be tested to ensure minimal leakage (less than 1.5 gpm) at gasket and ease of operation (40 pound maximum pull on hand wheel) at all points along travel. Length of travel shall be as shown on the drawings.
   9. Support Bracket: A cast iron, 316 or 304 stainless steel wall mounted support bracket to serve as a base for the floor stand shall be provided by the valve manufacturer.

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.

C. Flow Control Valve (FCV 1-1)
   1. Valve shall be 8-inch V405 plug valve.
   2. Actuator shall provide powered valve modulation for control of process variables.
   3. Special features on the flow control valves' electric operators:
      a. Equip the power actuator with an electronic control unit.
      b. Input signal: discrete open/close signal.
      c. Operate valve through the full stroke in response to the signal.
      d. Provide optically isolated signal inputs installed within the actuator enclosure.
      e. Provide field calibration capability.
      f. Operational temperature range: -20° to 65° C.
      g. Actuator shall be capable of up to 1200 starts per hour.
      h. Actuator arrangement shall be a multi-turn actuator coupled to a quarter turn gear box.
   4. Electric operators:
      a. Valve operators shall be AUMA; Limitorque; or equal.
      b. Actuators -- motor operated, 90 degrees open-close.
      c. The actuators shall be furnished and sized by the valve supplier and shall be factory mounted. The actuators shall be the electric motor gear train type consisting of motor controls, gearbox, geared limit switches and torque switches, and manual override handwheel with declutching lever. The actuators shall be capable of producing not less than 1-1/2 times the required operating torque. The actuators shall be of the self-locking type and shall operate the valve from fully opened to fully closed positions, or the reverse, in approximately 60 seconds. Actuator enclosure shall be NEMA 4X for all areas except NEC classified hazardous areas. Enclosures for classified areas shall meet NEC requirements for those areas.
      d. Motors shall be the high torque, reversible type totally enclosed, non-ventilated, 1,800 or 3,600 rpm, 120-volt, single-phase, 60 Hz, and shall have built-in thermal overload protection. Motors shall be prelubricated and all bearings shall be of the antifriction type.
      e. The gearbox shall be totally enclosed and gasketed with gears and shafts of heat-treated alloy or bronze, supported throughout by antifriction ball or roller bearings and permanently lubricated at the factory. Enclosure shall be ductile iron.

f. Actuator controls shall consist of reversing contactor motor controller, control power transformer, automatic reset overload relay, local control pushbuttons, indicating lights, LOCAL/OFF/REMOTE selector switch, terminal strip, and space heater. When the LOCAL/OFF/ REMOTE selector is in the REMOTE position, the actuator shall be controlled by external maintained OPEN and CLOSED contact inputs and shall provide a contact closure for REMOTE indication of the REMOTE position. When the LOCAL/OFF REMOTE selector is in the LOCAL position, the actuator shall be controlled by integral OPEN/CLOSE push buttons. The actuator controls shall accept either momentary or maintained OPEN and CLOSE contact inputs.

g. The actuators shall be equipped with automatic double-acting geared limit switches and double-acting torque switches. Limit switches shall be geared directly to the operating gear train and shall be of the adjustable type capable of being adjusted to trip at any point between fully opened and fully closed valve positions. Torque switches shall operate during the complete valve cycle to protect the valve from excessive loads met by obstructions in either direction of travel. The actuators shall provide one set of OPEN and CLOSED dry contact outputs for external use.

h. The actuators shall be equipped with handwheels for manual operation, which shall include an automatic clutch to positively disengage the handwheel at any time the drive motor control is energized. Handwheel operator shall be designed in such a way that failure of the motorized gearing shall not prevent hand operation of the valves.

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.

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. Section for reference only

B. Temperature Gauges and Fittings:
   1. Glass thermometers.
   2. Dial type insertion thermometers.
   3. Thermometer wells.

C. 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. º 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: TI-

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: Not used

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:
   a. ITT Barton Model 227 or 200.
   b. Or equal.
2. Dial Size: 4 ½-inch unless otherwise noted.
3. Accuracy: +2 percent of full scale.
4. Provide zero adjustment accessible from front.
5. Scale: Linear unless noted otherwise.
6. 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/DS.
   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:
   1. At suction and discharge of each pump.
   2. At discharge of each pressure reducing valve.

D. Install gauges in vertical upright position in the position most easily read by observer standing on floor.

E. 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-	

B. Pressure Differential Gauge:
   1. Not Required

C. Manometers:
   1. Not Required

D. Pressure Switches:

Location	Adjustable Operating Range	Rising Set Point
PSH-		

E. Diaphragm Seals:
   1. Not Required

F. Annular 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.
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.

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

PROCESS 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 as necessary.

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.
   3. Flexible Elastomeric Thermal Insulation:
      a. Armstrong World Industries, Inc.
      b. Rubatex Corp.
   4. Cellular Glass Insulation:
      a. Pittsburgh Corning

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.

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: Insulate all process piping indicated on pipe schedule drawing 20-M-1:
   1. Operating Temperature: As Scheduled (2 to 49 deg 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.

3.13 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Process piping indicated on pipe schedule drawing 20-M-1:
   1. Operating Temperature: As Scheduled (2 to 49 deg 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: Aluminum.
   5. Vapor Retarder Required: No.
   6. Finish: None.

END OF SECTION

SECTION 16001

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Summary of the Work, Instructions to Bidders and all sections of the Conditions of the Contract form a part of these Specifications and the Contractor shall consult them in detail.

1.2 SUMMARY

A. The Electrical drawings do not attempt to show complete details of building construction which affects the electrical installation. The Contractor shall refer to the complete set of project drawings and specifications for additional details, which affect the proper installation of this work.

B. The mention of any article, operation, or method requires that the Contractor shall provide same and perform each operation, in complete accordance with the conditions stated. The Contractor shall provide all material, labor, equipment and transportation as necessary to complete the project in compliance with the Contract Documents. In general, this work includes everything essential for a complete electrical system in operating order as shown on the drawings and as specified.

C. All work shall be installed in accordance with all State and Local Inspection Authorities having jurisdiction together with the recommendations of the manufacturer whose equipment is to be supplied and installed under this Contract. The omission of expressed reference to any item of labor or material necessary for the proper execution of the work in accordance with the present practices of the trade shall not relieve the Contractor from providing such additional labor and materials.

D. Before submitting his bid, each bidder shall examine the drawings relating to his work and shall become fully informed as to the extent and character of the work required and its relation to other work in the building.

E. The Contractor shall establish exact locations of all materials and equipment to be installed. Consideration shall be given to construction features, equipment of other trades and requirements of the equipment proper.

F. All materials shall be suitably stored and protected prior to installation and all work shall be protected after installation, during construction and prior to acceptance.

G. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by the

Contractor. All such equipment shall be removed by the Contractor upon completion of the project.

1.3 PERMITS AND LICENSES

A. The Contractor shall prepare and submit all applications and working drawings, as required, to authorities having jurisdiction over the project. All licenses and permits required shall be secured and paid for by the Contractor. The Contractor shall submit a copy of all permits secured to the Owner.

B. Provide the Owner with a written certificate that all parts of the electrical system have been inspected and final approval has been obtained from the appropriate authority having jurisdiction.

C. Provide a copy of the electrical permit to the Owner representative prior to proceeding with any work.

1.4 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. LFMC: Liquidtight flexible metal conduit.

D. RNC: Rigid nonmetallic conduit.

E. Provide: Furnish, install and wire complete and ready for service.

F. Exposed: Exposed to view in any room, corridor or stairway.

G. This Contractor: The Electrical Contractor, also referred to as "The Contractor".

H. Code: National, State and Local Electrical codes including OSHA requirements.

I. The Owner: The individual who the Owner selects as his project representative.

J. Equivalent: Manufacturers or methods listed by name in the specifications, on the drawings or in an addendum are considered to be equivalent subject to the review of the Owner/Engineer.

K. Substitution: Any manufacturer or method other than those listed by name in these specifications, on the drawings, or in an addendum.

L. Demo (Demolish): Detach item(s) from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

M. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage to surrounding surfaces, and deliver to Owner.

N. Remove and Reinstall: Detach item(s) from existing construction, prepare for reuse, and reinstall where indicated.

O. Existing to Remain: Existing item(s) of construction that are not to be permanently removed and that are not otherwise indicated to be demolished, removed and salvaged, or removed and reinstalled.

1.5 SUBMITTALS

A. Coordinate this sub section with Section 01330.

B. Submit to Engineer for review, the manufacturer's shop drawings and/or equipment brochures in quantities determined by the Engineer for the following:

1. Wiring devices.
2. Panelboards.
3. Motor Control Center.
4. Enclosed Switches and Circuit Breakers.
5. Enclosed Controllers.
6. Lighting Fixtures.
7. Sealing and Fireproofing.
8. Grounding materials.

C. Shop drawings shall be submitted in advance of construction and installation so as to not cause delay in other Contractor's work and to allow for Engineer's review.

D. All data submitted for Engineer's review shall be numbered consecutively, shall be noted to correlate with the electrical drawings, and shall bear:

1. The name and location of the project.
2. The name of the Contractor.
3. The date of submittal.
4. The date of the drawings and the date of each correction and revision.
5. If more than one type of lighting fixture (or other material) is on a submitted sheet, the proposed equipment shall be conspicuously checked with red pen by the Electrical Contractor.
6. Failure to do this, may result in the submittal(s) being returned to the Contractor for correction and re-submission.
7. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

E. The Contractor shall examine, stamp and sign shop drawings and equipment brochures prior to submission. The Contractor shall verify that the materials and equipment depicted will properly fit into the construction. The Contractor shall also review all previously completed work related to the installation of the equipment depicted to insure that it has been properly installed.

F. No materials or equipment subject to prior review by the Owner/Engineer shall be fabricated or installed by the Contractor. The Engineer's review of shop drawings shall not relieve the Contractor of responsibility for deviations from the requirements of the drawings and specifications, unless prior approval for such deviations has been granted.

G. Submit additional materials at the request of the Engineer.

H. Shop drawings shall bear the Contractor's stamp indicating approval or approved as noted.

I. Any equipment fabrication prior to shop drawing review shall be at the Contractor's risk.

1.6 MAINTENANCE MANUALS

A. Coordinate this sub section with Section 01730.

B. The Contractor shall assemble and submit to the Engineer for subsequent submission to the Owner, three complete sets of a Manual of Operation and Maintenance for each of the electrical and communications systems.

C. Each manual shall consist of a loose leaf bound volume instructing the Owner's personnel in the use, operation and maintenance of the system in question. The manual shall cover all phases of operation and maintenance of the equipment. Manuals shall accurately describe the operation, construction and adjustable features of the complete system and its component parts.

D. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

1. Copies of all reviewed submittals bearing Contractor's stamp indicating approval or approved as noted.
2. Manufacturer's wiring diagrams for electrically powered equipment.
3. Records of tests performed to certify compliance with system requirements.
4. Certificates of inspection by regulatory agencies.
5. Parts lists for manufactured equipment.
6. Preventive maintenance recommendations.
7. Warranties.
8. Additional information as indicated in the technical specification sections.

1.7 QUALITY ASSURANCE

A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed.

B. Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply

C. All work and material shall conform to the National Electrical Code (ANSI/NFPA 70).

D. All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by the Engineer, shall apply and such items shall bear those labels. Where one of the

approved electrical testing laboratories has an applicable system listing and label, the entire system, shall be so labeled.

1.8 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

B. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

D. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, light fixtures, panelboards, devices, etc.

E. Coordinate all work with other contractors/subcontractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

F. Conflicts Between Trades: Resolve all conflicts with trades at no additional cost to the Owner or Engineer.

1.9 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These specifications and attendant drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material necessary for the proper execution of the work in accordance with present practices of the trade shall not relieve the Contractor from providing such additional labor and materials. No later than ten (10) days before bid opening, the Contractor shall call the attention of the Engineer in writing to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted. If in the opinion of the Contractor there are omissions or errors in the plans or specifications, the Contractor shall clarify these points in writing with the Engineer before submitting his bid. In lieu of written clarification by addendum, resolve all conflicts in favor of the greater quantity or better quality.

B. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

C. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the Engineer's intent (as determined by the Engineer).

D. It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site with the Owner's representative and be responsible for their accuracy. Where appropriate the location shall be established in accordance with the manufacturer's installation drawings and details subject to the Owner/Engineer's review.

E. All sizes as given are minimum except as noted.

F. Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the Authority Having Jurisdiction inspections and Owner/Engineer's reviews, tests and approval from the commencement until the acceptance of the completed work.

G. Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

H. The Contractor shall refer to shop drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.

I. 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.

1.10 DRAWINGS

A. The Electrical drawings do not attempt to show the complete details of building construction which affect the electrical installation. The Contractor shall refer to the architectural, civil, structural and mechanical drawings for additional details which affect the proper installation of this work. Bring any discrepancies to the attention of the Engineer for resolution. The Contractor is cautioned that diagrams showing electrical connections and/or circuiting are diagrammatic only and must not be used for obtaining lineal runs of wire to conduit. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

B. The Contractor shall be responsible for all existing field conditions, review existing field conditions prior to bid and shall take into account in bid proposal. No additional compensation will be allowed due to Contractor's failure to include all necessary work in the bid proposal.

1.11 MATERIAL AND EQUIPMENT

A. All material and equipment shall be new and of the quality used for the purpose in good commercial practice, and shall be standard product of reputable manufacturers. Each major component of equipment shall have the manufacturer's name, catalog number, and capacity or rating on a nameplate, securely affixed on the equipment in a conspicuous place.

1.12 DAMAGE TO OTHER WORK

A. The Electrical Contractor will be held rigidly responsible for all damages to the work of his own or any other trade resulting from the execution of his work. It shall be the Contractor's responsibility to adequately protect his work at all times. All damages resulting from his operations shall be repaired or the damaged portions replaced by the party originally performing the work, (to the entire satisfaction of the Owner/Engineer), and all cost thereof shall be borne by the Contractor responsible for the damage.

1.13 COOPERATION WITH OTHER TRADES

A. This Contractor shall completely cooperate with all other trades in the matter of planning and executing of the work. Every reasonable effort shall be made to prevent conflict and interferences as to space requirements, dimensions, locations, openings, sleeving or other matters which tend to delay or obstruct the work of any trade.

1.14 NEGLIGENCE

A. Should the Contractor fail to provide materials, templates, etc., or other necessary information causing delay or expense to another party, he shall pay the actual amount of the damages to the party who sustained the loss.

1.15 FIELD CHANGES

A. Should any change in drawings or specifications be required to comply with local regulations and/or field conditions, the Contractor shall refer same to Owner/Engineer for approval before any work which deviates from the original requirements of the drawings and specifications is started. In the event of disagreements as to the necessity of such changes, the decision of the Owner/Engineer shall be final.

1.16 CUTTING AND PATCHING

A. Provide all necessary cutting and patching, and with approval, to permit the installation of conduit or any part of the work under this branch. The Contractor shall be responsible for any cost caused by defective or ill-timed work. Patching of holes, openings, etc. resulting from the work of this branch shall be provided by this Contractor.

1.17 STANDARDS, CODES AND PERMITS

A. All work and materials are to conform in every detail to applicable rules and requirements of National, State and Local electrical codes, laws, ordinances, and regulations. Comply with all applicable OSHA regulations.

B. Conform with other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

C. All Division 16 work shall be done under the direction of a currently State Certified Master Electrician.

D. All materials shall have a U.L. label where a U.L. standard and/or test exists.

E. Prepare and submit to all authorities having jurisdiction, for their approval, all applications and working drawings required by them. Secure and pay for all permits and licenses required.

F. Abbreviations of standards organizations referenced in this and other sections are as follows:

1. ANSI American National Standards Institute
2. ASTM American Society for Testing and Materials
3. EPA Environmental Protection Agency
4. ETL Electrical Testing Laboratories, Inc.
5. IEEE Institute of Electrical and Electronics Engineers
6. IES Illuminating Engineering Society
7. ISA Instrument Society of America
8. NBS National Bureau of Standards
9. NEC National Electric Code
10. NEMA National Electrical Manufacturers Association
11. NESC National Electrical Safety Code
12. NFPA National Fire Protection Association
13. UL Underwriters Laboratories Inc.

1.18 CLEAN-UP

A. This Contractor shall at all times keep the premises free from excessive accumulation of waste material or rubbish resulting from his work, including tools, scaffolding and surplus materials, and he shall leave his work broom-clean or its equivalent. In case of disputes, the Owner/Engineer may order the removal of such rubbish and charge the cost to the responsible contractor as determined by the Owner/Engineer. At the time of final clean-up all fixtures and equipment shall be thoroughly cleaned and left in proper condition for their intended use.

B. The Contractor shall repair all damage to new and existing equipment resulting from his work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

1.19 TESTS

A. General: The Contractor shall provide all instrumentation, labor and conduct all tests required by the Engineer. All tests shall be made before any circuit or item of equipment is permanently energized. Circuits shall be phased out and loads shall be distributed as evenly as possible on all phases. All phase conductors shall be entirely free from grounds and short circuits. All instrumentation and personnel required for testing shall be provided by the Contractor and all tests shall be conducted in the presence of the Owner/Engineer or his authorized representative.

B. System Tests:

1. Service and building ground tests.

2. Secondary feeders shall have an insulation resistance test utilizing a megger applying a test potential of 500 volts DC minimum.
3. Establish secondary phase to ground voltages.
4. Set transformer taps to deliver nominal rated voltage.
5. Establish proper phase relationship and motor rotation.

The following tests are required under normal load condition:

6. Record secondary phase to phase and phase to ground voltages and phase currents at all major equipment, apparatus, and on all secondary feeders. Voltage readings shall be taken at line side terminals of distribution centers and panelboards.
7. Confirm proper phase relationship and motor rotation.
8. Confirm load balance at Motor Control centers and panels. Rebalance load if necessary such that the minimum unbalance between phases shall not exceed 7-1/2%.
9. Reset transformer taps if necessary to deliver nominal rated voltage. Identify final tap settings on transformers nameplates.
10. Confirm operation of all electrically operated apparatus, such as circuit breakers, transfer switches, etc., by exercising same under load.
11. Record all settings and calibrations of circuit breakers, transfer switches, transformers, meters, timing devices, etc.

C. Records: All test data obtained by the Contractor or manufacturer/supplier shall be recorded and filed with the maintenance manual as part of permanent job records. Test data shall include identification of instruments employed, (field test only) condition of test (time, date, weather, etc.), parameters of test, personnel conducting test, and any pertinent information or conditions noted during the test.

1.20 DRAWINGS OF OTHER TRADES

A. The Contractor shall consult the drawings of the work for the various other trades; field layouts of the parties performing the work of the other trades; their shop drawings, and he shall be governed accordingly in laying out his work.

B. Specifically examine shop drawings of other trades to confirm voltage, current characteristics, and other wiring requirements for utilization equipment. Bring any discrepancies to the attention of the Owner/Engineer.

1.21 FIELD MEASUREMENTS

A. The Contractor shall take all field measurements necessary for his work and shall assume the full responsibility for their accuracy.

B. Should any structural interferences prevent the installation of the outlets, running of conduits, etc., at points shown on drawings, the necessary minor deviations therefrom, as determined by the Engineer, may be permitted. Minor changes in the position of the outlets or equipment if decided upon before any work has been done by the Contractor shall be made without additional charge.

1.22 EXAMINATION OF PLANS, SPECIFICATIONS AND SITE

A. Before submitting a bid, the Contractor shall familiarize himself with all features of the building and site which may affect the execution of his work. No extra payment will be allowed for the failure to obtain this information.

1.23 GUARANTEE

A. The Contractor shall unconditionally guarantee his work and all components thereof, excluding lamps, for a period of one year from the date of his final payment. He shall remedy any defects in workmanship and repair or replace any faulty equipment which shall appear within the guarantee period to the entire satisfaction of the Owner/Engineer at no additional charge.

1.24 DEMOLITION, RENOVATION AND DISPOSITION OF EXISTING EQUIPMENT.

A. This Contractor shall note that the existing building will remain in service during portions of the construction period. Areas of the building will be vacated as required to facilitate construction. This Contractor shall proceed with the completion of his work in such a manner as to cause the least possible interference with the Owner's operation. All work required in the existing building shall be done in a manner and time acceptable to the Owner. Outages and other work rendering existing equipment inoperative shall be held to a minimum - prior arrangements for each shall be made with the Owner and shall be acceptable as to time and duration

B. Electrical equipment in conflict with construction shall be removed and/or relocated as indicated on the drawings, as directed or required. This Contractor shall remove all electrical equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. The Owner shall have the privilege to retain ownership of any electrical equipment that has been removed, and all such equipment shall be relocated to a designated temporary location for storage until removed by the Owner. All other equipment, conduit, conductors, and miscellaneous hardware removed shall become the property of this Contractor and shall be removed from the site.

C. This Contractor shall be responsible for the work of other trades as may be necessary to facilitate the installation of electrical work in the existing building. Such work necessary that is normally done by other trades and is not covered as a part of other Divisions of the work shall be done under the direction and at the expense of the Electrical Contractor.

D. This work shall include but is not limited to, cutting, patching, and refinishing and all necessary and required to leave existing building in condition acceptable to the Owner/Engineer.

E. Any existing circuits or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction shall be reconnected in an approved manner. In addition, any existing circuit or equipment which may require relocation or rerouting, as a result of construction, shall be considered a part of the work of this branch and shall be done by this Contractor with no additional compensation.

F. All coring that is required for electrical work shall be by this Contractor.

1.25 SUBSTITUTION AND APPROVAL OF MATERIAL, EQUIPMENT OR DESIGN

A. Such requests shall be accompanied by three copies of all necessary illustrations, cuts, drawings and descriptions of material proposed for substitution and shall fully describe all points in which it differs from the articles specified. The Engineer will retain two copies and one copy returned to the Contractor with acceptance, rejection or revisions indicated thereon.

B. The proposed substitution does not affect dimensions shown on Drawings or as specified.

C. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

D. All proposed substitutions will be subject to satisfactory performance to the specification and considered as a deduct alternate rather than as an equivalent.

E. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs, including architectural/engineering design and construction costs, involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed.

F. All substitution review costs shall be reimbursed to the Engineer by the contractor or their suppliers on a Time/Material bases. This cost shall be paid on approval on disproval of the substitution material, equipment or design.

1.26 WORKMANSHIP

A. The installation of all work shall be made so that its several component parts will function as a workable system complete with all accessories necessary for its operation, and shall be left with all equipment properly adjusted and in working order. The work shall be executed in conformity with the best-accepted standard practice of the trade so as to contribute to efficiency and appearance. It shall also be executed so that the installation will conform and adjust itself to the building structure, its equipment and its usage.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Expansion Anchors: Carbon-steel wedge or sleeve type.

G. Toggle Bolts: All-steel springhead type.

H. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 CONCRETE BASES

A. Concrete: 3000-psi, 28-day compressive strength.

B. Provide a 4" or 6" housekeeping pad under any floor mounted electrical equipment as shown on drawings or as directed by the Engineer.

2.3 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Install equipment grounding conductors in all feeders and circuits.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
   a. Field Welding: Comply with AWS D1.1.
7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement. See Section 03300 for other information.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Concrete bases.
6. Electrical demolition.
7. Cutting and patching for electrical construction.
8. Touchup painting.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:
   1. Ground rods.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports to include the following:

   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with UL 467.

1.5 COORDINATION

A. Show location of all service grounding equipment and describe method of grounding installation. Show the following:

1. Service ground conductor.
2. Grounding at water meter.
3. Counterpoise system.
4. Location of Ground Rods.
5. Telephone/Data grounding equipment and conductor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:
2. Apache Grounding/Erico Inc.
3. Boggs, Inc.
4. Chance/Hubbell.
5. Copperweld Corp.
6. Dossert Corp.
7. Erico Inc.; Electrical Products Group.
8. Framatome Connectors/Burndy Electrical.
9. Galvan Industries, Inc.
10. Ideal Industries, Inc.
11. ILSCO.
12. Kearney/Cooper Power Systems.
13. Korns: C. C. Korns Co.; Division of Robroy Industries.
14. O-Z/Gedney Co.; a business of the EGS Electrical Group.
15. Raco, Inc.; Division of Hubbell.
16. Salisbury: W. H. Salisbury & Co.
17. Superior Grounding Systems, Inc.
18. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 16120 "Conductors and Cables."

B. Material: Copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type (at bus bars, equipment, and test wells only).

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad Stainless steel.

1. Size: 3/4 by 120 inches in diameter.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Underground Grounding Conductors: Use tinned- copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the Motor Control Center to equipment grounding bar terminal on busway.

E. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

H. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on grounding bus.

3.3 SUPPORT INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

E. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

    a. Equipment Rated 500 kVA and Less: 10 ohms.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More Than 1000 kVA: 3 ohms.
    d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLATING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil,

fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on white field.
2. Legend: Indicates voltage and service.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Brass or Aluminum Tags: 2 by 2 by 0.05-inch metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

B. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.

C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.
3. Apply one intermediate and one finish coat of enamel.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:

a. Fire Alarm System: Red.
b. Mechanical and Electrical Supervisory System: Green and blue.
c. Telecommunication System: Green and yellow.

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

I. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder phase conductors:

1. 208/120-V Conductors:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

2. 480/277-V Conductors:
   a. Phase A: Yellow.
   b. Phase B: Brown.
   c. Phase C: Orange.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

   a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
   b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and Motor Control Center rooms.

1. Legend: 1/4-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Emergency system boxes and enclosures.
4. Disconnect switches.
5. Enclosed circuit breakers.
6. Motor starters, Motor Control Centers.
7. Push-button stations.
8. Contactors.
9. Control devices.
10. Transformers.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

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 CONDUCTORS AND CABLES

A. Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 ; stranded conductor.

D. Conductor Insulation Types: Type THHN-THWN UF USE and SO complying with NEMA WC 5.

E. Multiconductor Cable: Metal-clad cable, Type MC Type SO and Type USE with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

H. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 16001 “Common Work Results for Electrical".

F. Seal around cables penetrating fire-rated elements.

G. Identify and color-code conductors and cables according to Section 16075 " Electrical Identification."

H. The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

I. Conductor sizes indicated on the drawings are minimum sizes. Ampacities of conductors do not take voltage drop into consideration. Contractor shall size conductors for feeders and branch circuits to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combination of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest outlet does not exceed 5 percent, to provide reasonable efficiency of operation.

1. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Section 16001 "Common Work Results for Electrical" for supports and anchors.
2. Section 16075 “Electrical Identification” for identification products.
3. Section 16140 "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

C. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Detail assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Location of all feeders. Raceway and pull boxes as listed below:

a. Distribution conduits/boxes.
b. Motor conduits (above 1").

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Equipment conduit/boxes (above 30 amps in size).

D. Location of all disconnects/motor starter and mounting method.

E. Location of all distribution/branch circuit feeders, pull boxes and panelboards.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

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 METAL CONDUIT AND TUBING

A. Manufacturer:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

D. EMT and Fittings: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturer:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.
14. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
15. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
16. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturer:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 3R.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type flanged-and-gasketed type.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

1. Manufacturer:

a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).

b. Thomas & Betts Corporation.
c. Walker Systems, Inc.; Wiremold Company (The).
d. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.

10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard grey paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel.
2. Concealed: Rigid steel.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.

4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

    a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. EMT Conduit: Use steel compression.
2. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated. Type with insulated throat (no cast).
3. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Section 16001 "Common Work Results for Electrical."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.

3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.
1. Use insulating bushings to protect conductors.

K. Tighten set screws of threadless fittings with suitable tools.

L. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Q. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

S. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

T. Outlets:

1. Locations of outlets and electrical equipment on the drawings are approximate only. Unless otherwise indicated on the drawings or established in the specifications, the exact locations of electrical outlets shall be established in the field by directive from the Owner/Engineer. Generally, outlets shall be located as required for proper installation of equipment served and otherwise locations shall be established by construction or code requirements and such as to be coordinated with equipment of other trades.
2. This Section shall consult with the Owner/Engineer and refer to all details, sections, elevations and equipment plans and the plans of other trades for exact location.
3. The Engineer reserves the right to make reasonable changes in the location of outlets, apparatus or equipment up to the time of roughing in. Such changes as directed shall be made by the Contractor without additional compensation.
4. Dimensions taken by scale shall not be used to establish rough-in locations.
5. No back-to-back units, offset outlet boxes on opposite side of wall a minimum of 12 inches.

U. Wiring Devices:

1. The approximate locations of wiring devices are indicated on the drawings; the specific locations shall be determined in accordance with "Location of Outlets" of these specifications and as follows.
2. This section is referred to equipment plans, equipment shop drawings, elevation drawings and other detail or dimensional drawings, and he shall consult with the Engineer before installation of outlet boxes for wiring devices or before proceeding with any work dependent upon this information.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles, ground-fault circuit interrupters, weather resistant receptacles.
2. Device wall plates.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - GENERAL

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

a. Cooper Wiring Devices.
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Mfg. Company Inc.
d. Pass & Seymour/Legrand

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight-Blade and Locking Receptacles: Heavy-Duty Specification Grade.

C. GFCI Receptacles: Straight blade, Heavy-Duty Specification Grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

D. Weather Resistant Receptacles: Straight blade, Extra Heavy-Duty Specification Grade, weather resistant, comply with NEMA WD 1, NEMA WD 6, Fed. Spec. W-C-596G, NEC 406.8(A) and 406.8(B), and UL 498. Configuration NEMA 5-15R and 5-20R, 125V duplex receptacle listed as weather resistant type.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

B. Snap Switches: Heavy -Duty grade, quiet type.

C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-15R.

D. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable slider toggle switch; with single-pole or three-way switching to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.
3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.6 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5 jacks for UTP cable.

2.7 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
2. Size: Selected to fit nominal cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 5 voice and data communication cables.

2.8 MULTIOUTLET ASSEMBLIES

A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: Metal, with manufacturer's standard finish.

C. Wire: No. 12 AWG.

2.9 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

1. Poles: Nominal 2.5-inch- square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
3. Finishes: Satin anodized-aluminum.
4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors; and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.

5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6, Configuration 5-20R units.
6. Voice and Data Communication Outlets: Four RJ-45 Category 5 jacks.

2.10 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: As selected by Engineer, unless otherwise indicated or required by NFPA 70.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Wrap wiring devices with insulating tape before installing and placing plates.

C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

D. All receptacles installed in damp and wet locations shall be listed weather resistant type.

E. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

F. All receptacles installed in Dwelling Units in all areas specified in NEC Article 210.52 shall be listed tamper-resistant receptacles.

G. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.

H. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

3.2 IDENTIFICATION

A. Comply with Section 16075 "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Section 16060 "Grounding and Bonding."

B. Connect wiring according to Section 16120 "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Feeder and branch-circuit protection.
2. Motor and equipment disconnecting means.

B. Related Sections include the following:

1. Section 16140 "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Current and voltage ratings.

c. Short-circuit current rating.
d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fusible Switches:
   a. Square D Co.
2. Molded-Case Circuit Breakers:
   a. Square D Co.
3. Combination Circuit Breaker and Ground-Fault Trip:
   a. Square D Co.
4. Molded-Case, Current-Limiting Circuit Breakers:
   a. Square D Co.
5. Integrally Fused, Molded-Case Circuit Breakers:
   a. Square D Co.

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with 5 -mA trip sensitivity.
7. Molded-Case Switch: Molded-case circuit breaker without trip units.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional with field-adjustable 0.1- to 0.6-second time delay.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 FACTORY FINISHES

1. Manufacturer's standard prime-coat finish ready for field painting.
2. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075 "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
e. Coordination drawing of location and layout.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For testing agency.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Engineer's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Square D.

2.2 MANUFACTURED UNITS

A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.

1. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

D. Service Entrance Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

B. Main Overcurrent Protective Devices: Circuit Breaker.

C. Branch Overcurrent Protective Devices:

1. For Circuit Breaker Frame Sizes 125A and Smaller: Bolt-on circuit breakers.
2. For Circuit Breaker Frame Sizes Larger Than 125A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 30mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

PART 3 - PRODUCTS

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Install overcurrent protective devices and controllers.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075 "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Section 16060 "Grounding and Bonding."

B. Connect wiring according to Section 16120 "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16443

MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.

B. Related Sections include the following:

1. Section 16001 "Common Work Results for Electrical"

1.3 SUBMITTALS

A. Coordinate this sub section with Section 01330.

B. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: For each motor-control center.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current ratings of buses and installed units.
d. Vertical and horizontal bus capacities.
e. UL listing for series rating of overcurrent protective devices in combination controllers.
f. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for class and type of motor-control center. Differentiate between manufacturer-installed and field-installed wiring. Provide schematic wiring diagram for each type of controller.

D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Field Test Reports: Written reports specified in Part 3.

F. Manufacturer's field service report.

G. Maintenance Data: For motor-control centers, all installed devices, and components to include in maintenance manuals specified in Section 01730. In addition to requirements specified in Section 01700 include the following:

1. Routine maintenance requirements for motor-control centers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to satisfactorily conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for motor-control centers, including clearances between motor-control centers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle motor-control centers according to NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers." Use factory-installed lifting provisions.

C. Store motor-control centers indoors in clean, dry space with uniform temperature to prevent condensation. Protect motor-control centers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

D. If stored in areas subjected to weather, cover motor-control centers to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer at least two days in advance of proposed utility interruptions. Identify extent and duration of utility interruptions.
2. Indicate method of providing temporary utilities.
3. Do not proceed with utility interruptions without Owner/Engineer’s written permission.

1.7 COORDINATION

A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-in-Place Concrete."

C. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 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.

1. Spare Fuses: Furnish one spare for every **five** installed, but not less than one set of **three** of each type and rating.
2. Indicating Lights: **Two** of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Motor-Control Centers with Manual and Magnetic Controllers:
   a. Square D Co.

2.2 MOTOR-CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class **I, Type A**.

B. Enclosures: surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
1. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
2. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center. Interchangeability of units requiring the same size compartment and constructed to permit ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
3. Wiring Spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.3 BUSES

A. Material: Plated **copper**.

B. Ampacity Ratings: As indicated for horizontal and vertical main buses.

C. Neutral Buses: **Half** size.

D. Equipment Ground Bus: Noninsulated, horizontal copper bus 2 by 1/4 inch (50 by 6 mm), minimum.

E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

F. Short-Circuit Withstand Rating: Same as short-circuit current rating of section.

2.4 FUNCTIONAL FEATURES

A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.

B. Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.

1. Install units with full-voltage, across-the-line, magnetic controllers up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
3. Equip units in Type B and Type C motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections.

C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

D. Transient Voltage Surge Suppressors: Connect to motor-control center bus.

E. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

F. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated "spare."

2.5 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

B. Control Circuit: 120 V; obtained from **integral control power transformer** with a control power **transformer** of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

C. Combination Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.
2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

D. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class **10** tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

2.6 FEEDER OVERCURRENT PROTECTION

A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
5. Molded-Case Switch: Molded-case circuit breaker without trip units.

B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses with lockable handle.

2.7 MOTOR-CONTROL CENTER ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

2.8 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine **areas** to receive motor-control centers for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. See Section 16001 "Common Work Results for Electrical" for general electrical installation instructions.

B. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-control center mounting surface.

C. Install motor-control centers on concrete bases complying with Section 03300 "Cast-in-Place Concrete" and project drawings.

D. Comply with mounting and anchoring requirements specified by manufacturer and on project drawings.

E. Controller Fuses: Install fuses in each fusible switch.

3.4 IDENTIFICATION

A. Identify motor-control center, motor-control center components, and control wiring according to Section 16075 "Electrical Identification."

B. Operating Instructions: Frame printed operating instructions for motor-control centers, including control sequences and emergency procedures. Fabricate frame of finished metal and cover instructions with clear acrylic plastic. Mount on front of motor-control centers.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Section 16120 "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:

C. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

D. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection indicated in NETA ATS, Sections 7.5, 7.6, and 7.16.
2. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting solid-state controllers.

F. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

A. Clean controllers internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.10 STARTUP SERVICE

A. Verify that motor-control centers and components are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

END OF SECTION